MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
A STATEWIDE HIGHWAY TRANSPORTATION PLAN

road and street responsibilities

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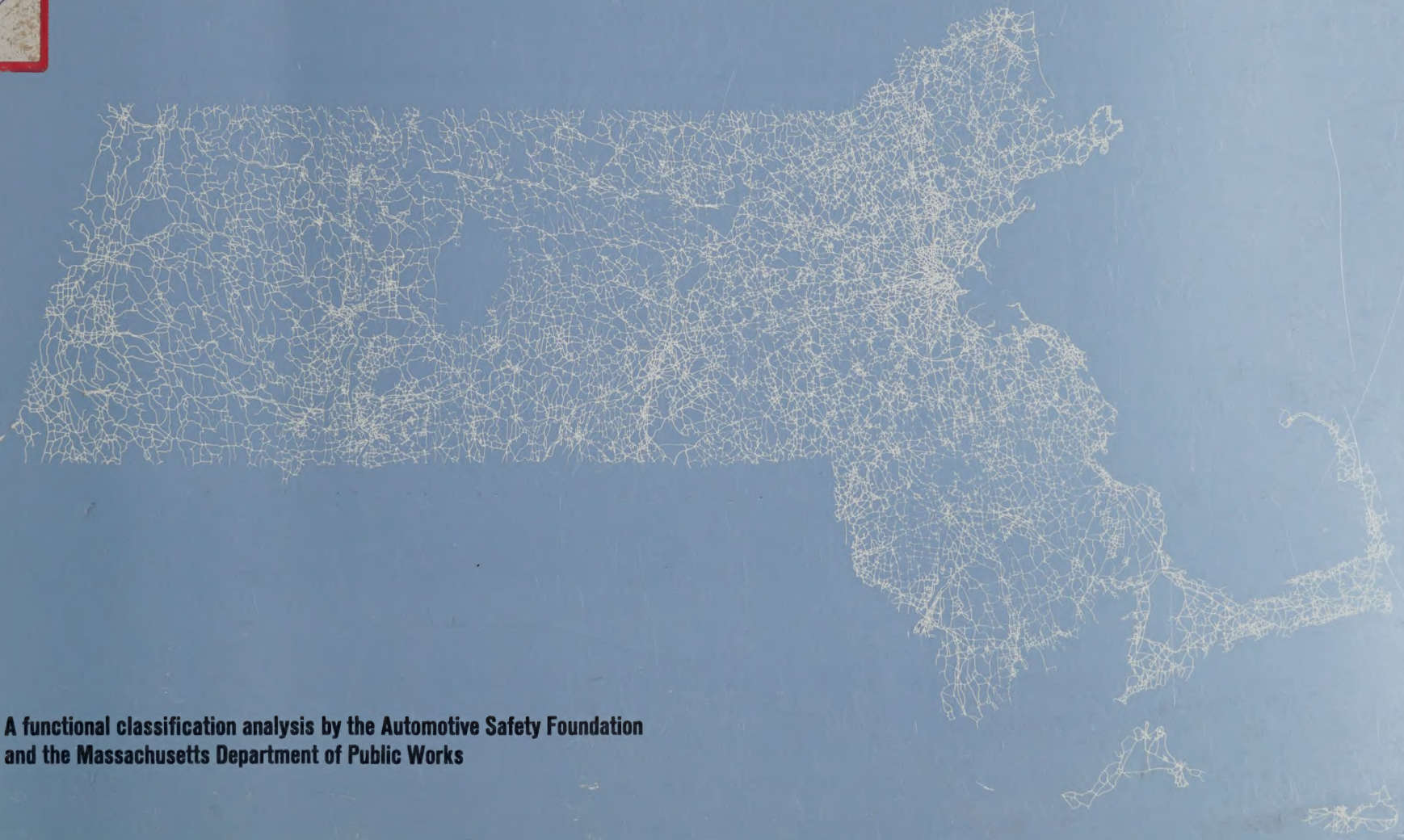

A functional classification analysis by the Automotive Safety Foundation and the Massachusetts Department of Public Works

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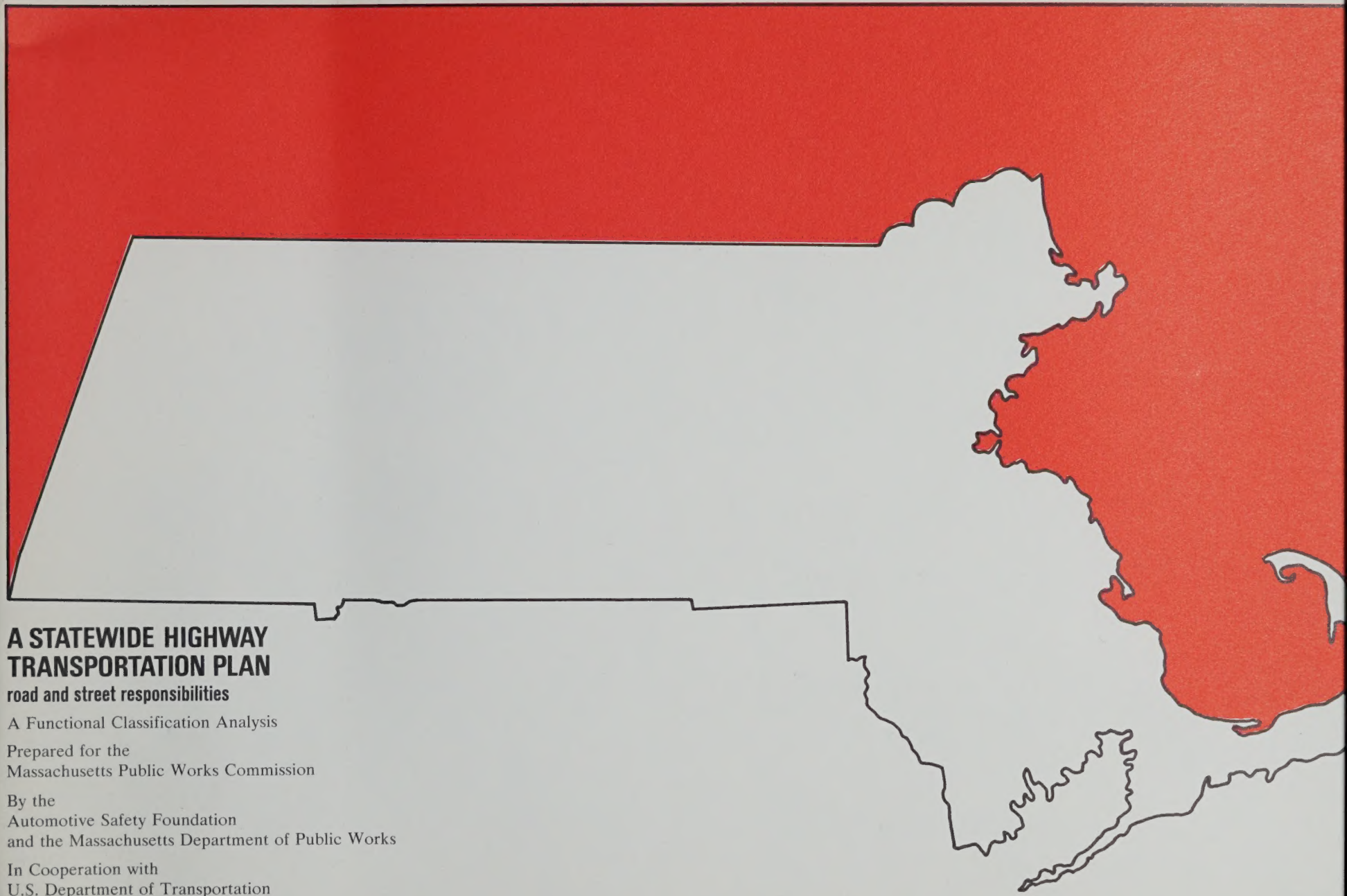

A STATEWIDE HIGHWAY TRANSPORTATION PLAN

road and street responsibilities

A Functional Classification Analysis

Prepared for the
Massachusetts Public Works Commission

By the
Automotive Safety Foundation
and the Massachusetts Department of Public Works

In Cooperation with
U.S. Department of Transportation
Bureau of Public Roads

September, 1968

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September 15, 1968

Mr. Edward J. Ribbs, Commissioner
Department of Public Works
100 Nashua Street
Boston, Massachusetts 02114

Dear Commissioner Ribbs:

In accordance with an agreement dated April 12, 1966 between the Commission and the Foundation we are pleased to transmit this report entitled "A Statewide Highway Transportation Plan - Road and Street Responsibilities." The report is one of a series of three resulting from the comprehensive statewide highway study authorized by the Commission in December, 1965.

The recommendations contained herein, together with the companion studies of highway needs and fiscal policies reported separately, constitute a basis for reshaping the highway function in Massachusetts to provide improved services and more efficient administration.

Foundation engineers accept full responsibility for the contents and recommendations of this report. The work was accomplished by Department personnel with assistance from city and town officials, under technical supervision of M. F. Reed, Highway Engineer, with general direction by S. F. Coffman, Deputy Chief Engineer, for the Highway Engineering Division of the Foundation.

The cooperation of the Department, other state agencies, municipal officials and the U. S. Bureau of Public Roads is gratefully acknowledged.

Very truly yours,

J. P. Buckley

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FOREWORD

In December 1965, the Massachusetts Public Works Commission authorized the Bureau of Transportation Planning and Development to undertake a Statewide Highway Transportation Study involving a comprehensive examination of the entire road and street network of the Commonwealth. The study was carried out in three separate, but interrelated phases: (1) a functional analysis of road and street responsibilities, (2) an appraisal of present and future physical needs and costs, and (3) an evaluation of highway fiscal policies and requirements.

The study was financed jointly by the Massachusetts Department of Public Works and the U.S. Department of Transportation, Bureau of Public Roads, as a Federal-aid highway planning project.

Overall direction of the total study was the responsibility of the Massachusetts Department of Public Works, Bureau of Transportation Planning and Development. The Automotive Safety Foundation of Washington, D.C. was retained to advise and assist the Bureau of Transportation Planning and Development in the highway classification phase of the study. Allinson, Inc., of Warwick, Rhode Island was retained to advise and assist on the highway needs and fiscal phases.

The Automotive Safety Foundation is an industry supported, non-profit organization dedicated to education and research for safe, efficient highway transportation. Foundation engineers have participated in studies of a similar nature in a majority of the states.

As a preliminary step to the study the Bureau of Transportation Planning and Development undertook an inventory of all public roads and streets. The inventory information, obtained by field surveys, was coded in a form usable for electronic data processing. In addition, a series of up-to-date highway maps of the entire state was prepared based on aerial photographs and the road inventory data.

This report, "A Statewide Highway Transportation Plan—Road and Street Responsibilities," sets forth the fundamentals of sound highway classification and recommends the establishment of firm and clearly defined state highway, town road and city street systems. The recommendations are based on a functional classification of the total Massachusetts public road network, and also on consideration of the results of the companion phases of the study, reported separately. While the classification study was carried on cooperatively by Foundation and state personnel aided by town and city officials, the contents, conclusions, and recommendations of this report are the responsibility of the Foundation.

Chapter I examines significant historic and economic factors affecting highway transportation and the existing division of responsibilities for construction and upkeep of Massachusetts' road and street network. Chapter II describes concepts, methods and results of classifying roads and streets by functional classes based upon their relative importance to the state's economy and the character of traffic usage. In the last chapter a plan is recommended for reassigning road and street responsibilities among levels of government to provide more efficient highway transportation facilities.

To achieve utmost effectiveness in orderly highway, road and street development, the recommendations of this report must be considered with, and related to, results of the companion study of future highway fiscal policies and requirements reported separately.

SUMMARY

The citizens of Massachusetts live in a time of change. Growing population, increasing urbanization, and demands for higher standards of living pose numerous and difficult problems of public policy. Not the least of these is how to provide an adequate and soundly financed system of roads and streets to safely and efficiently serve highway transportation requirements.

All facets of the state's economy and welfare depend, in whole or in part, upon highway transportation. Every citizen benefits from the road and street network either directly as a user, or indirectly as a result of the services made possible. Family living, the operations of trade, industry, business and agriculture are intimately related with the daily use of motor vehicles, in carrying workers to their places of employment, housewives to their shopping, children to classes and in serving the distribution and production needs of commercial enterprises.

The cornerstone of sound highway policy in every state is system classification. Because all roads and streets are not equally important, choices must be made. System classification is a rational orderly process by which responsibility for various roads and streets is assigned among the several levels of government. It determines which roads and streets should be under state control and which should be city or town responsibility for most efficient development and operation.

Since 1893, when by legislative action a Massachusetts Highway Commission was first organized to take over, lay out and maintain roads connecting the more important cities, there have been many changes in road and street responsibilities among state and municipal governments. Conditions today make it abundantly clear that a more equitable and satisfactory balance in responsibilities is needed. Highways of greatest importance to all the people of the state are in some cases a state responsibility—in others a city or town responsibility. On the other extreme, a substantial mileage of existing state highways are relatively unimportant and of direct benefit to a limited area or a few people only. As a result the public is not receiving the kind of highway service it needs and the burden of finance is not divided equitably among the taxpayers.

Correction of the existing imbalances and inconsistencies can come about only through establishment of a firm and logical road and street classification plan related to a firm and equitable finance plan for meeting road and street needs. The three companion reports of the Statewide Highway Transportation Study provide the essential facts needed by legislators and public officials to accomplish those objectives.

Recommended Systems Plan

The reorganization of road and street responsibilities recommended in this report brings together, as separate administrative systems, roads and streets of similar service characteristics requiring the same degree of technical competence in their design, construction, maintenance and operation. The recommended plan assigns responsibility for each system to the level of government having the greatest basic interest therein. It provides a basis for efficient management and intergovernmental coordination of road and street affairs which minimizes conflicts between governmental agencies. It forms a base to which finance policies can be related with definite promise of accelerated and orderly development of the state's road and street network.

Assigned to state responsibility is a proposed State Primary System composed of Interstate, principal and major highways and a State Secondary System composed of collector and community service highways. Functional characteristics of the different classes of highways comprising the recommended state systems are defined in the report. The Department of Public Works should be solely responsible for both rural and urban portions of the State Primary and Secondary Systems.

A firm long-range state fiscal plan for balanced development of the recommended state systems should be established based on findings of the com-

RECOMMENDED SYSTEMS PLAN

System and Ownership	*Miles*	*Percent*	
		Total Miles	Total Travel
State Ownership:			
Primary System	2,125	7.4	43.7
Secondary System	2,142	7.4	12.5
	4,267	14.8	56.2
City and Town Ownership:			
Major Arterial System	3,050	10.6	18.6
Minor Arterial System	2,703	9.4	5.4
Local Access System	18,399	63.7	14.8
	24,152	83.7	38.8
Other roads and streets	423	1.5	5.0
	28,842	100.0	100.0

panion needs and finance studies reported separately.

As shown by the accompanying table the recommended plan would place about 15 percent of all public road and street mileage under state control. In the 48 contiguous states, 25 state highway departments control less than 15 percent of all mileage and 23 have more.

Together the proposed state systems connect all places in the state over 1,000 population. The routes comprising the two systems carry most traffic of statewide interest and are most essential to the welfare of all the people. Approximately 83 percent of the state's total population and 98 percent of its major industrial plants are within one mile of routes of the combined systems.

Two administrative systems of municipally owned arterial roads and streets should be established, one a Major Arterial System consisting of regional, primary urban and secondary urban arterials and the other a Minor Arterial System of town and tertiary arterials as defined in the study. All remaining municipally owned roads should comprise a Local Access System.

A limited mileage of other roads and streets should remain under the jurisdiction of agencies presently responsible for them. These include toll facilities operated by the Turnpike Authority and the Port Authority, roads administered by the Metropolitan District Commission with the exception of those forming segments of the recommended state systems, and public roads within federal, state and local reservations.

Establishment of the recommended State Primary and Secondary Systems, clearly defined as to character and extent, as the sole responsibility of the Department of Public Works will give all jurisdictions a firm foundation to plan for orderly future road development. At present, responsibility for the 4,267 miles of roads and streets comprising the recommended state systems is shared by the Department and 247 cities and towns. This fragmentation of responsibility on routes of similar character and importance is contrary to accepted principles of good management and is not in the public interest. With state control of routes of statewide importance, muncipalities can concentrate resources on the development of roads and streets of regional and local importance.

Coordination of Road and Street Management

Responsibilities for the three recommended municipally owned road and street systems must be firmly coupled with a suitable financial policy established by the General Court. The finance plan should involve state aid funds proportionate to the degree of state interest in each municipal system determined equitable by the companion fiscal study.

With 351 cities and towns sharing responsibility for the recommended municipal road and street systems effective coordination of management and engineering activities is imperative for orderly integrated progress and optimum use of financial resources.

In establishing the revised state aid finance policy the General Court should direct the Department of Public Works to provide increased leadership and guidance to municipal authorities in administration of road and street affairs. Such activities should be directed toward achievement of sound objectives and not to control of the day-to-day operations of local highway agencies. Cities and towns should manage road and street affairs autonomously within guidelines established for planned orderly systems development.

Priority Programing

Priority programing for highway development is a process for rational selection of construction projects based on relative urgency, systematically scheduled within limits of available resources to carry out legislative and administrative objectives for system development.

The General Court should require the Department of Public Works, within two years, to develop and adopt factual systematic priority programing for state highway construction programs. The process should be the basis for preparation of separate six-year advance construction programs for each system and each functional class. The advance programs should be published and updated at least every biennium to keep planning continually six years ahead of development. The steps involved in effective priority programing are outlined in this report.

Federal-Aid Systems

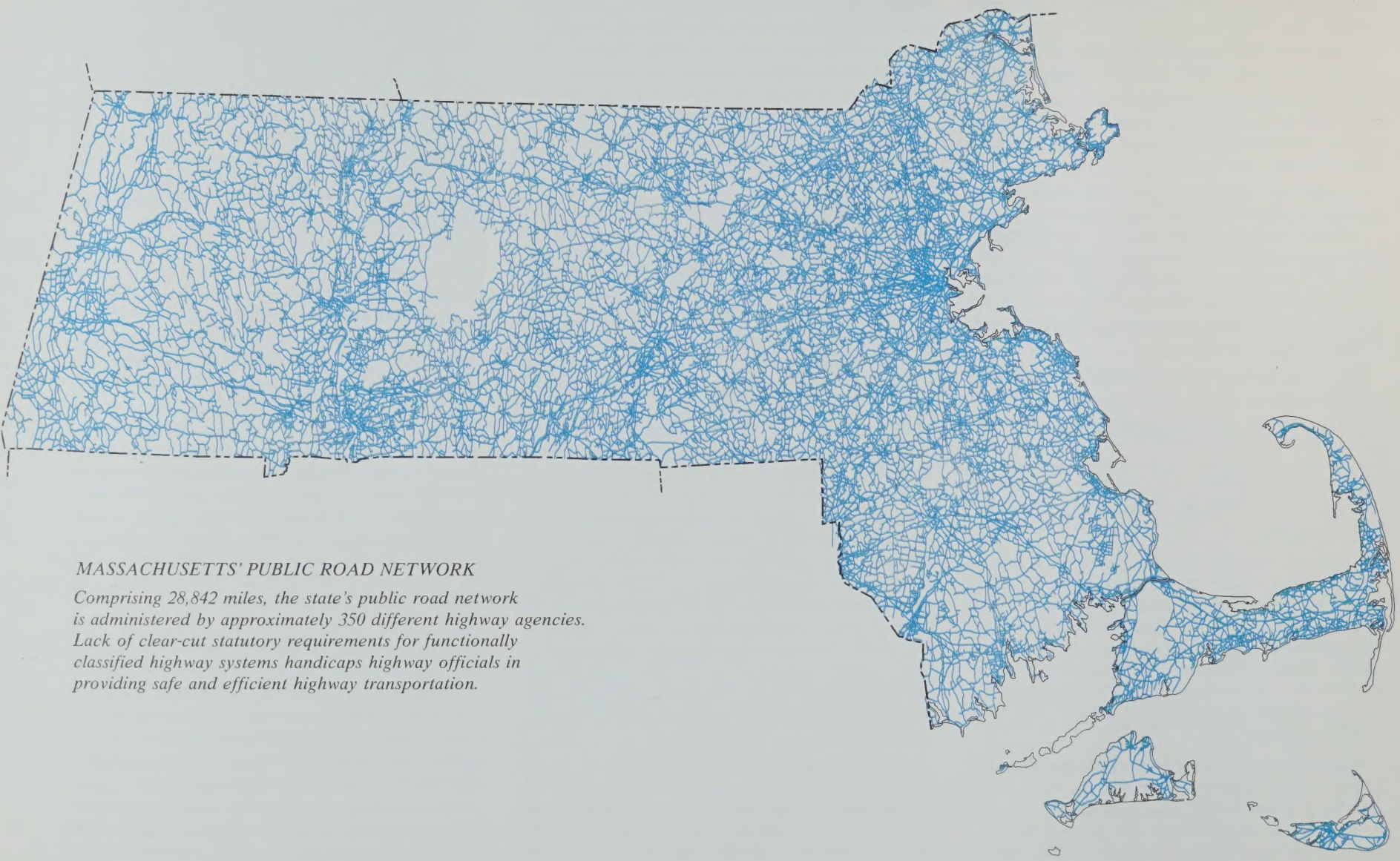
Existing Federal-aid Systems should be modified to make possible more orderly utilization of the various classes of Federal-aid funds under the recommended classification plan. This can be accomplished by joint action of the Department of Public Works and the U.S. Bureau of Public Roads.

The Federal-aid Primary System should be adjusted to coincide with the recommended State Primary System. The Federal-aid Secondary System should be adjusted and expanded to coincide with the recommended State Secondary and City and Town Major Arterial Systems. While providing no additional federal funds to Massachusetts, coincident systems would facilitate fiscal planning and simplify management problems.

Conclusion

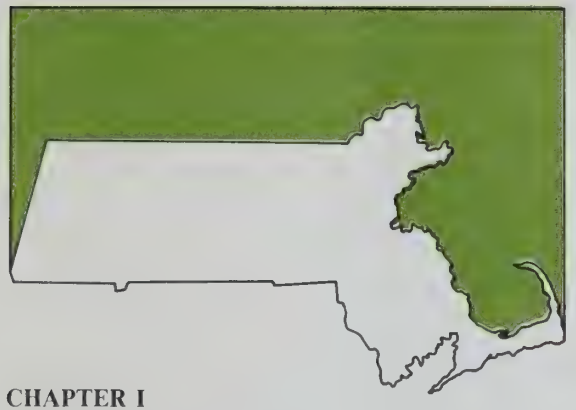
With annual highway travel in Massachusetts forecast to increase to 37 billion vehicle miles by 1990 (a gain of 74 percent over 1965 travel) stabilized road and street systems, on which suitable long-range finance plans and physical development programs can be based with confidence, are vital to Massachusetts' continued well being.

The recommendations set forth in the three companion study reports constitute a sound basis for reshaping the highway function in Massachusetts to obtain optimum efficiency and maximum benefits from highway expenditures.



MASSACHUSETTS' PUBLIC ROAD NETWORK

Comprising 28,842 miles, the state's public road network is administered by approximately 350 different highway agencies. Lack of clear-cut statutory requirements for functionally classified highway systems handicaps highway officials in providing safe and efficient highway transportation.



CHAPTER I
THE HIGHWAY PROBLEM

The public road network in Massachusetts totals 28,842 miles, including about 90 miles of planned routes committed to construction but as yet unbuilt. What agencies share responsibility for construction and maintenance of this network? Which roads are the responsibility of each agency? Is the present division of responsibility logical and in the public interest? Is assignment of responsibilities related to traffic needs and functional importance of each road? Does it provide a firm basis for efficient management and effective intergovernmental coordination? Would reorganization of road and street responsibilities among the various governmental agencies provide improved services and promote increased efficiencies in operations? These questions are dealt with in this functional analysis of road and street responsibilities.

Travel and Economy

Massachusetts' public road network is depicted in the map on page 4. The pattern of the network reflects the effects of population density, economic activity and topographic conditions. The network is logically most closely spaced in areas with high population densities and high rates of economic activity. Conversely, areas with low population density and major land and water barriers have fewer roads.

Obviously all roads comprising the total network are not of equal importance. Some are multilane facilities serving major flows of interstate and intrastate travel. Others are primarily of regional or community interest. Many only provide access to adjacent land, farms and residences. Despite these differences in character they all contribute to the movement of people and goods and serve the state's total economy in varying degree.

The operations of industry, business and agriculture, as well as the basic habits of family living revolve around highway service and the availability of adequate road and street facilities. Two-thirds of the 2.3 million employed persons in Massachusetts travel to and from work by private car, either as drivers or passengers in car pools.

Manufacturing, which employs about one-third of all workers, is a key factor in the economy of the state's larger population centers. The manufacturing industry depends increasingly on highway transportation for movement of raw materials and finished products.

In recent years electronic and communication equipment and electrical machinery have become the state's leading products. These industries have located many new plants close to Massachusetts expressways to provide convenient access for workers and facilitate in-bound and out-bound shipments essential to operations.

The multimillion dollar tourist industry adds materially to the state's economy. Cape Cod, the Berkshires, the North Shore, ski resorts, lakes and mountains and many other natural and historic points of interest in Massachusetts, attract vacationers annually from throughout the United States. Most vacation travel is by motor vehicle. Hence the tourist industry is almost entirely dependent upon highway transportation for its existence.

To provide continuity in design, maintenance and traffic services, state highways in Massachusetts should form a continuous system, as in most states.

Public Transportation

Public transportation is a continuing concern in Massachusetts. High-speed rail transportation between Boston and New York and intermediate metropolitan areas is under development. The Massachusetts Bay Transportation Authority is undertaking a large program to extend and rehabilitate rail rapid transit lines. The bus system in the Boston metropolitan area is being consolidated. A balanced future transportation solution is being sought in the Boston metropolitan area through the comprehensive urban transportation planning process. However, for the present and foreseeable future, Massachusetts' streets and highways are the prime facilities for surface transport.

Future Travel

As the state's economic activities continue to increase more highway traffic will be generated and the demand for highway services will intensify. Anticipated growth patterns of highway travel must therefore be considered in planning for future highway development.

Based on past trends, Massachusetts' population should reach about 7.1 million by 1990, an increase of 34 percent over the 1965 population of 5.3 million. More people means more motor vehicles and more travel.

In 1950 there were 27 motor vehicles registered in Massachusetts for each 100 persons. By 1965 this ratio had increased to 40 vehicles per 100 persons. The trend in vehicle ownership is expected to continue upward reaching a ratio of 50 vehicles per 100 persons by 1990.

The projected growth in population combined with the increasing rate of motor vehicle ownership will result in a total motor vehicle registration of about 3,527,000 by 1990 compared with 2,193,000 reported for 1967. Annual highway travel is forecast to increase to 37 billion vehicle miles by 1990, a gain of 74 percent over 1965 travel.

Responsibilities and Relationships

About 350 different highway agencies share responsibility for administration of Massachusetts' 28,842 mile public road network. The table on page 9 shows the agencies involved and extent of responsibility. Over 1,500 officials have a voice in deciding how and where available road and street funds are spent. To achieve maximum efficiency, close cooperation between the many agencies is necessary; responsibilities must be in keeping with resources and the technical competence available.

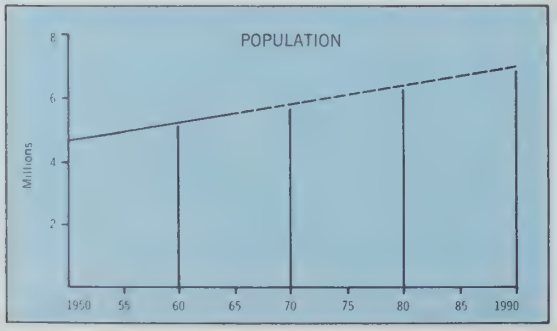
State Highways

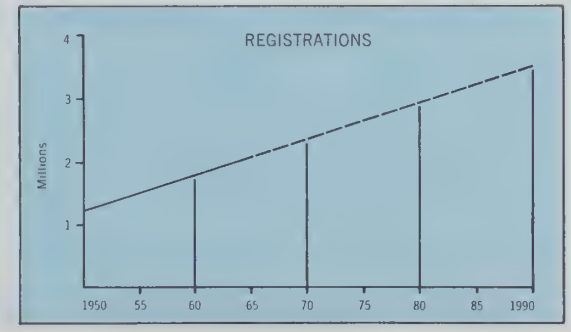
The 2,688 miles of state highways (including about 90 miles of planned but not yet built Interstate Highways) represent slightly more than nine percent of total public road mileage. All are the responsibility of the Department of Public Works. Some state highways serving major travel corridors have been built to expressway design standards. Some are lesser arterial roads serving as regional connectors. Others serve merely as access roads to farms or residences.

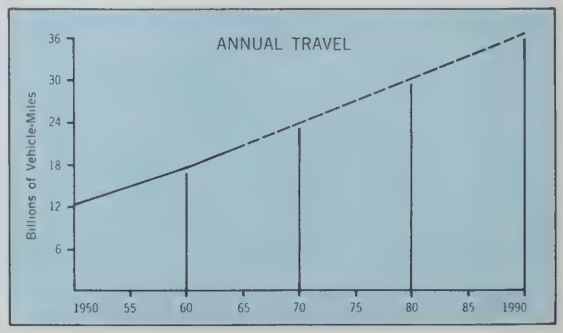
Furthermore, state highways in Massachusetts do not form a continuous system as shown by the map on page 7. In many cases the Department of Public Works responsibility ends at the outskirts of an urban area, and the extension of a route within the urban area is the responsibility of a city or town. In other cases, isolated rural segments of highway are the state's responsibility.

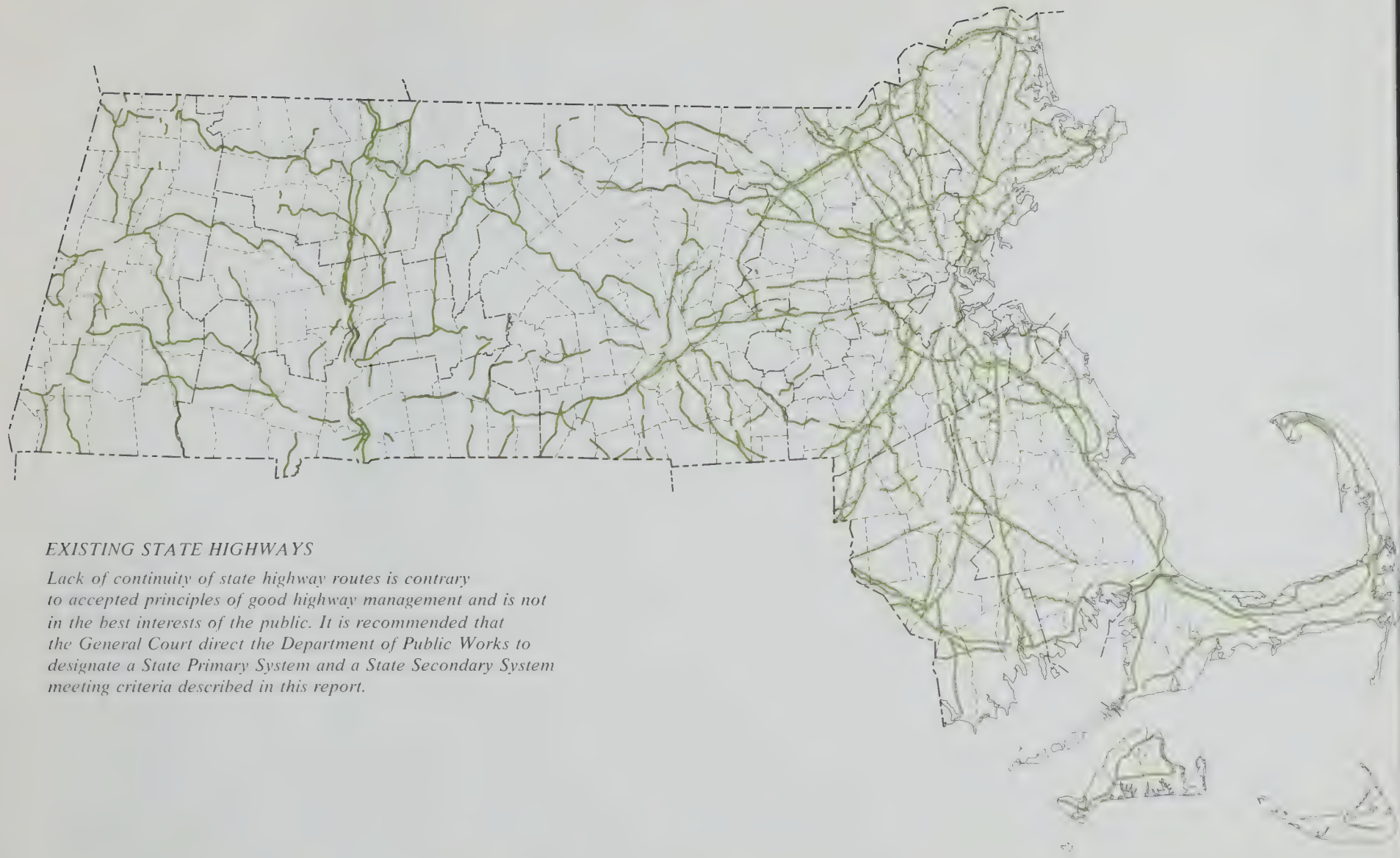
State responsibility for highways in Massachusetts is limited to those sections of routes constructed by the Department of Public Works and financed from state and Federal-aid funds. Initially road sections were short, scattered and confined almost entirely to rural areas. Over the years many gaps between the earlier rural construction sections were closed but comparatively little mileage was built within urban areas. Boston, for example, has only 14 miles of state highways today out of a total of 864 miles of streets within the city. In Springfield only five out of 440 miles of streets are state highways.

Until relatively recent years there has not been a firm concept of state highway route continuity. Even now it is limited to controlled access highways on new locations such as the routes of the Interstate System; Route 3 from Quincy to the Cape Cod Canal; Route 24 from 128 to Fall River; Route 128,









EXISTING STATE HIGHWAYS

Lack of continuity of state highway routes is contrary to accepted principles of good highway management and is not in the best interests of the public. It is recommended that the General Court direct the Department of Public Works to designate a State Primary System and a State Secondary System meeting criteria described in this report.

NUMBERED HIGHWAY SYSTEM

The 4,000 mile numbered system of Massachusetts highways is composed of most, but not all, existing state highways plus connecting links under the jurisdiction of cities, towns and other agencies. Most citizens believe the entire numbered system is a state responsibility.

the circumferential of the Boston metropolitan area and similar facilities.

Massachusetts law delegates authority to the Department of Public Works for constructing and maintaining state highways. But the law neither specifies the function of state highways nor describes general or specific guidelines as to their intended extent. The law does not establish, or require designation of, a State Highway System. As a result, state highways have been designated over the years on a piecemeal basis in accordance with funds available and limited planning objectives.

Numbered Routes

There is a numbered system of Massachusetts highways totaling about 4,000 miles. The numbered routes form a continuous system throughout the state as shown by the map on page 8. This system resulted from a Legislative Act of 1928 providing for signing and marking of highway routes for the convenience of motorists.

The numbered system is composed of most, but not all, of the existing state highway mileage, plus connecting links under the jurisdiction of cities, towns and other agencies.

For example, of the approximately 28 miles of U.S. Route 1 from Route 128 south of Boston to Route 128 north of Boston, nine miles are the responsibility of the Department of Public Works, 14 miles are the responsibility of the Metropolitan District Commission and the remaining five miles are the responsibility of Brookline, Boston, Everett and Malden through which the route travels.

On this section of U.S. 1, road design changes even more often than changes in jurisdiction. Sections range in width from two lanes to eight lanes and include all the possible variations in number of lanes between those extremes.

Many citizens of Massachusetts today are unaware that the entire numbered system is not state responsibility and that many links, some of substantial length, on these main travelled highways are under the jurisdiction of local highway agencies. This division of responsibility on the important backbone routes of the state's total road and street network is not in keeping with modern principles of highway management, nor does it best serve traffic needs.

Metropolitan District Commission Roads

Approximately 150 miles of roads in the Boston metropolitan area are the responsibility of the Metropolitan District Commission, an agency also concerned with water supply, sewage disposal and park facilities in the metropolitan area. Included are about 40 miles that are urban portions of several important statewide arterial routes. Most other MDC roads serve in varying capacities as urban arterial streets or provide access to parks and other recreational facilities.

Originally MDC roads were a parkway system intended to connect park and recreation areas and to link centers of population with the park system. As early as 1925, the Boston Park Department, in a report, *Future Playgrounds and Parkways,* recognized that the parkway system could provide, and in fact would be forced to provide, automobile traffic capacity to supplement inadequate city streets. The parkways with wide borders of grass, waterways, plantings and trees were easily susceptible to widening, at first for intersection improvements and then for limited widenings and finally realignment of roadways.

The 1925 report suggested that there would be a powerful incentive to defer street improvement, which would require taking homes and businesses, in favor of widening parkways where right of way could be acquired at little or no cost. The report also pointed out that connections with major arterials would adversely affect the parkways by making them, in effect, segments of the arterial street system. The prophecies of that report have been abundantly realized.

While the parklike corridors along MDC routes have been diminished, they still exist and should be retained to enhance the urban environment. However, the function of the 40 miles of MDC roads that are portions of statewide arterial routes, no longer relates solely to the green strips through which they pass. These arterials serve primarily as conveyors of long distance traffic throughout the Boston metropolitan area and must be evaluated accordingly.

City Streets

Within the 39 cities there are about 6,900 miles of streets comprising 24 percent of the state's total highway transportation network. Cities are responsible for upkeep of 6,443 miles, or about 94 percent of the total street mileage within their boundaries. This high percent of city responsibility for streets results from the extremely limited mileage of state highways within Massachusetts' cities. Nationwide, state highways within city boundaries represent 13 percent of total city street mileage.

In addition to the many segments of routes serving major flows of statewide traffic, cities are responsible for internal arterials connecting focal points of traffic origin and destination as well as residential access streets. Despite this wide range in usage, state law makes no provision for classifying city streets according to service characteristics. Most cities have designated arterial street systems to

PRESENT ROAD AND STREET RESPONSIBILITIES

Agency	*Miles*	*Percent*
Department of Public Works	2,688	9.3
39 Cities	6,443	22.4
312 Towns	19,242	66.7
Metropolitan District Commission	149	0.5
Massachusetts Turnpike Authority	134	0.5
Federal, State and Local Reservations and Port Authority	186	0.6
Total	28,842	100.0

facilitate control of traffic. These systems do not necessarily, however, constitute a firm basis for fiscal planning and orderly long range development programs.

Fundamental to sound street management are adequate authority and resources to do the job. The existing illogical division of responsibility for urban extensions of statewide arterials and the lack of statutory requirements for functionally classified street systems related to equitable fiscal policies handicaps city officials in providing for the safe and efficient movement of traffic and are not in the public interest.

Town Roads

Towns in Massachusetts range in size from less than 200 population in the smallest rural town to over 50,000 population in the largest urban town. Many urban towns are as densely populated as some Massachusetts cities. The town of Brookline, for instance, closely resembles its neighboring cities in terms of population density and land use. The 312 towns are responsible for 19,242 miles of road, or about two-thirds of Massachusetts public road network.

As in the case of city streets, state law does not require classification of town roads by purpose or function. Most of the more important statewide arterials serving towns are state highways. But some routes of statewide and interregional importance are town responsibility.

There is often a lack of consistency from town to town. For example, Route 23 is a town road in Monterey, and a state highway in the towns of Great Barrington to the west and Otis to the east. A two-mile section of Route 62 in Princeton is a state highway, yet for a distance of 11 miles to the west and seven miles to the east along the route, towns are responsible for maintenance and development. Route 16 is another example of a town road serving long distance, high volume traffic, through Wellesley, Natick and Sherborn.

In many towns where statewide arterials are a local responsibility noticeably lower levels of improvement and service exist than on adjacent state highway sections. Most functions of highway management are technical in nature and, to be carried out effectively, require engineering direction. A few towns do have full-time professional engineers, with competent staff and organization, in charge of their road function. But most do not. All too frequently road management is on a part-time basis and primarily oriented to maintenance activities and minor betterments. Improvement projects are almost entirely dependent upon the availability of state aid funds.

Other Roads

The Massachusetts Turnpike Authority is responsible for the Massachusetts Turnpike extending the breadth of the state from the New York line to downtown Boston and the Sumner and Callahan tunnels under Boston Harbor.

In the Boston metropolitan area the Massachusetts Port Authority is responsible for the Mystic River Bridge and a limited mileage of other facilities.

A total of 179 miles of public roads within the boundaries of parks, forests and state and county institutions are administered by various governmental agencies.

State Aid Program

Limited financial assistance to cities and towns for street and road purposes is provided by the state under provisions of Chapters 81 and 90 of the General Laws. These state aid funds are expended under the general supervision of the Massachusetts Department of Public Works. The laws do not define a State Aid Road System nor do they limit the types of roads and streets for which state aid funds are available.

All facets of economic and social life are intimately related to the daily use of motor vehicles as evidenced by the demand for parking at the new Burlington Mall adjacent to Route 128.

Chapter 81

State aid funds provided by Chapter 81 are limited to towns with 1945 state-equalized assessed valuations of less than $5 million. Funds are apportioned on a mileage basis and may be used for maintenance, repairs and improvements. There are 182 towns that qualify for state aid under Chapter 81. In the smaller towns these state aid funds are a sizeable portion of total monies expended for road repair and winter maintenance.

Basing qualification for distribution of Chapter 81 funds on 1945 property valuations is not equitable for present day conditions. While assessed valuations in 1945 may have provided a reasonable gauge of each town's ability to finance road maintenance at that time, ensuing changes in economic status have altered assessed valuations disproportionately among towns. The growth of property valuations in towns where large new industries have located has been far greater than in towns that have not seen major changes. As a result, some towns now benefiting from Chapter 81 funds have larger tax bases than some of the towns not eligible for these funds.

Chapter 90

Chapter 90 authorizes state aid funds for construction and maintenance of city streets and town roads. Funds are apportioned based on area, population and road mileage. On construction projects, funds are available on a 25-25-50 percent matching basis between the city or town, the county and the state, respectively. However, all land damage costs are borne entirely by municipalities. The cost of land damage is a deterrent factor in making many needed improvements. For maintenance, state aid funds are available on a 1/3-1/3-1/3 matching basis.

Annually, cities and towns present proposed construction programs to County Boards of Com-

missioners and the Department of Public Works. The Department reviews proposals and approval is based on a number of criteria. Consideration is given to such items as whether the project is on a Federal-aid Primary or Secondary route, on a numbered route, on a direct and convenient route of travel between centers of population, on a feeder route from a population center to a state highway, or on a route leading to points of public interest.

In general, the Department of Public Works prepares construction plans and furnishes most of the needed engineering service for construction supervision, although some counties participate in varying degrees in preliminary surveys and designs. Construction may be accomplished either by contract or performed by city or town forces.

Absence of statutory criteria and requirements for firm highway, road and street classification to guide selection and approval of state aid construction projects has raised many questions in the past by local authorities as to the intended use of state aid funds. Clearly defined objectives, and equitable fiscal policies related to need, would provide state and local highway officials the basis for carrying out a more meaningful state aid program.

Federal-aid Highway Program

In Massachusetts, as in all other states, three administrative systems of public highways are eligible for Federal participation in the financing of construction or reconstruction: Federal-aid Interstate, Primary and Secondary Systems. These systems have been mutually agreed upon over the years by the Massachusetts Department of Public Works and the U.S. Department of Transportation, Bureau of Public Roads.

Throughout the United States, the National System of Interstate and Defense Highways is a 41,000-mile full freeway system to be built and maintained by the various state highway departments. As a result of national planning policy governing location of the Interstate System, 44 state capitals and 90 percent of all cities of 50,000 or more population will be linked together by freeways. The system serves urban areas by through and belt-line routes, or by spur connections to by-passes.

The economic well-being of downtown areas require adequate arterial streets to relieve congestion.

The Massachusetts portion of the Interstate System is 453 miles, of which 359 were open to traffic at the end of 1967. The Massachusetts Department of Public Works has built or is planning to build 318 miles of the Interstate System as state highways. The Massachusetts Turnpike Authority and the Massachusetts Port Authority have built 135 miles as toll facilities.

The Federal-aid Primary System, of which the Interstate System is a part, totals 2,364 miles including 1,784 miles of existing state highways. The remaining mileage is composed of city streets, town roads, toll facilities and Metropolitan District Commission roads.

The Federal-aid Secondary System in Massachusetts totals 2,305 miles, of which 596 are presently state highways. The remaining miles are city streets or town roads.

Federal funds, collected as highway user taxes, will provide 90 percent of the cost of constructing Interstate Highways. Up to the limit of Federal-aid apportionments to Massachusetts, 50 percent of the cost of approved construction or reconstruction of Federal-aid Primary and Secondary Highways is also paid from Federal funds.

Highway Systems in Other States

State highway systems in the 48 contiguous states average 20 percent of total road and street mileage. This includes mileage of state secondary systems in 19 states. Primary state highway systems alone average about 13 percent of all miles, nationwide.

The proportion of state highway mileage varies from as high as 90 percent in four states, where nearly all rural roads are state responsibility, to as low as six percent in two states. In 25 states, state highway systems do not exceed 15 percent of total road and street mileage.

State highways, in most states, form a continuous system extending into and through urban areas. In 31 states, construction and maintenance of state

FEDERAL-AID SYSTEMS
Interstate System
Primary System
Secondary System

highway systems, including portions within all urban areas, is the sole responsibility of the state. In at least 12 other states the state highway department is responsible for all state highway routes in smaller cities. The size of city varies from state to state, ranging from 3,000 population and under in Oklahoma, to all cities in Georgia except Atlanta. In some states, there is substantial state financial assistance to the larger cities for urban state highways in lieu of direct state responsibility. For instance, in Virginia cities over 3,500 population receive $10,000 per mile per year for maintenance and upkeep of state primary highways within their boundaries. In no state, except Massachusetts, are there extensive rural segments of important statewide arterials which are not state responsibility.

For the northeastern states, exclusive of Massachusetts, state highways average 21 percent of total road and street mileage. This includes state secondary systems in three states. The following table shows the extent of state highway responsibility by system in each state as a percent of total mileage.

State	*State Primary System*	*State Secondary System*	*Total*
Connecticut	7	13	20
Maine	17	37	54
New Hampshire	13	16	29
New York	13	—	13
Rhode Island	21	—	21
Vermont	16	—	16

Massachusetts, with state highway mileage representing nine percent of the total public road network, has the lowest percent of state highway responsibility among the New England states and is one of the lowest in the United States.

Significance of Highway Classification

The cornerstone of sound highway policy in any state is system classification. It is a framework around which road and street responsibilities can be uniformly assigned to appropriate levels of government and upon which sound and equitable finance plans can be based.

Failure to properly classify roads and streets underlies the basic highway problem in Massachusetts today. It is clear that past practices have not achieved an equitable and satisfactory balance in road and street responsibilities among governmental agencies. Facilities of highest economic importance to the general welfare of the state are in some cases a state responsibility—in others a city or town responsibility. On the other extreme, a substantial mileage of existing state highways are of relatively low economic importance and of interest to a limited area or a few people only. As a result, the public is not receiving the kind of highway transportation service it needs and the burden of finance is not divided equitably among the taxpayers.

The significance of rational balanced road and street systems as a base for engineering and fiscal planning is summarized in a separate section on this page. The listed purposes, like functional balanced systems themselves, are totally interrelated. In serving one purpose, they also can and do serve the others.

The end product is increased efficiency and safety in the total highway transportation network. To achieve this in Massachusetts and meet the demands of the future will require major adjustments in present policies and practices.

Significance of Systems

Balanced road and street systems are the foundation for

- appropriate assignment of responsibility to government agencies involved in highway transportation;
- equitable and consistent tax policies correlated with system function;
- allocation of funds to meet defined goals varying with system importance and needs;
- administrative organization and management policies keyed to the several systems;
- effective intergovernmental relations based on full understanding of stabilized responsibilities;
- planning on a regional and statewide basis to meet present and future community, traffic, and safety needs;
- design of facilities in keeping with their importance and function;
- traffic control, signing, and maintenance designed for maximum service, safety, and economy;
- priority programing of all improvement projects and operations.

CHAPTER II
FUNCTIONAL SYSTEM CLASSIFICATION

Each public road and street in Massachusetts was examined to determine its relative importance, without regard to existing legal and administrative jurisdiction, in serving the economy and the motoring public. Roads and streets providing similar traffic services were grouped. The highest classified group forms a complete interconnected system of roads of similar importance including connections with adjacent states. Successively the lesser classes of roads were joined with the higher class or classes, to form an expanding system. The process was continued until all public roads and streets were included in the network. This process resulted in a functional highway classification plan that served as the basis for the reassignment of road and street responsibilities among levels of government recommended in Chapter III.

Functional Classification Theory

To determine relative road importance, the function of each road was examined. Roads have at least two distinct functions—first, to serve traffic passing through a specified area and second, to serve local traffic destined to, or originating from, the area's homes, farms and other facilities.

Except for limited access expressways (term used synonymously with "freeways" in Massachusetts) which exclusively serve through traffic, and except for local dead-end roads which exclusively serve traffic generated by adjacent land facilities, all other roads serve combinations of through and local traffic. Roads that predominantly serve local traffic are termed access roads.

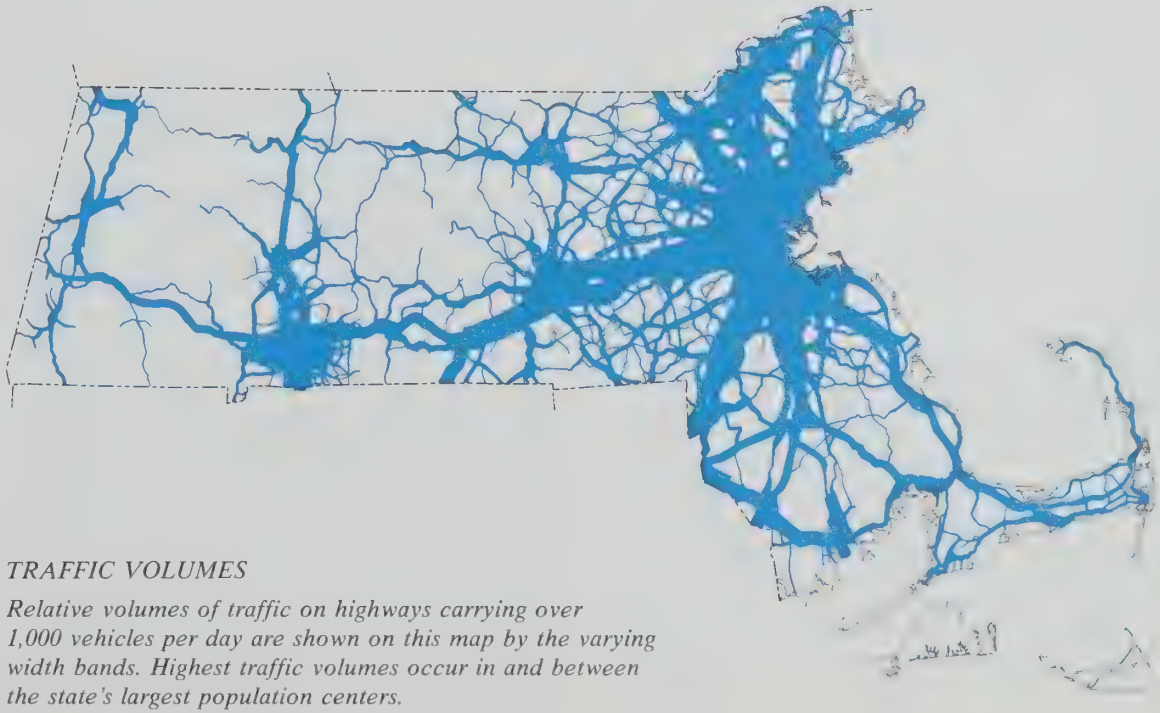
Arterial highways, streets and roads are further segregated according to their degree of importance to through traffic. Classes of statewide, rural area-wide and urban arterials have been established.

Guiding Principles

The division of Massachusetts' 28,842 mile public road and street network (including uncompleted sections of the Interstate Highway System) into functional groups or classes was based on a set of guiding principles. Each functional class was selected to:

- connect centers of similar economic and traffic interest,
- provide for system continuity,
- serve a similar range of trip distances,
- serve a similar range of traffic magnitude,
- concentrate traffic service,
- provide area balance,
- utilize best developed existing routes, and
- serve committed future development.

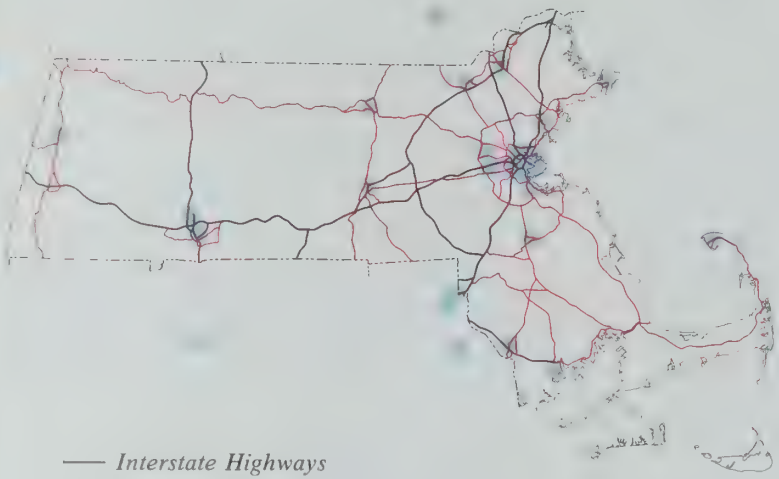
No single principle or formula can wholly define functional road classes. Therefore, the guiding principles were applied simultaneously in selecting the appropriate functional classification for each road or street.



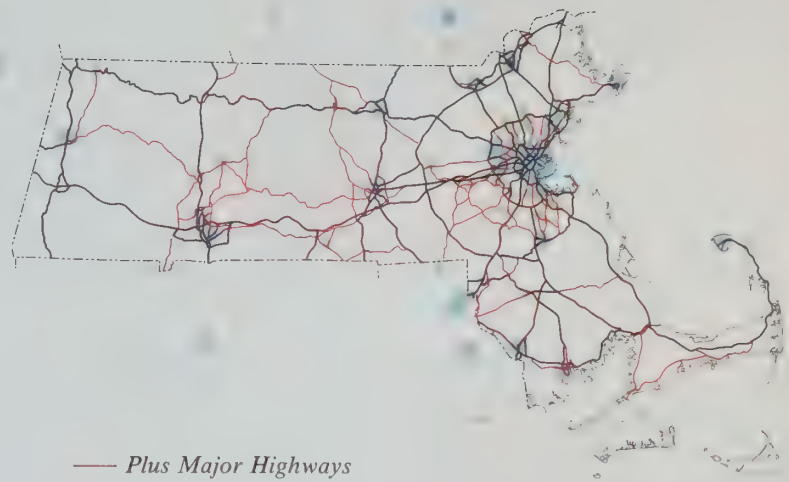
TRAFFIC VOLUMES

Relative volumes of traffic on highways carrying over 1,000 vehicles per day are shown on this map by the varying width bands. Highest traffic volumes occur in and between the state's largest population centers.

DEVELOPMENT OF STATEWIDE FUNCTIONAL HIGHWAY CLASSES



— *Interstate Highways*
— *Principal Highways*



— *Plus Major Highways*

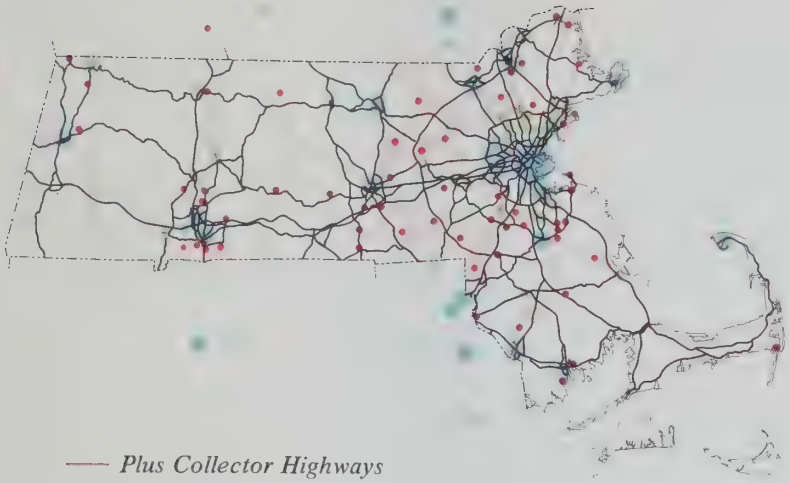
Connect centers of similar economic and traffic interest. Traffic spreads throughout residential and agricultural areas as motorists begin or end each trip at scattered individual homes and farms. Conversely, traffic concentrates at points of economic and social interest. These points, or defined areas of traffic interest, must be connected to provide for traffic interchange between centers. In general, the more important the center in terms of population, value of goods produced, number of persons employed, value of merchandise sold, etc., the greater the economic contribution of travel to and from the center. Hence roads between the most heavily populated, economically important centers are of greatest functional importance and generally the most heavily travelled. At the other extreme, roads that do not connect centers, but merely serve residential dwellings, carry light traffic of a relatively low order of importance to the state's economy. In between these extremes the ranking, grouping and connection of centers with similar characteristics establishes intermediate levels of functional road importance.

Provides for system continuity. Road networks, like water supply and electrical or sanitary sewage systems, must provide for continuity. Efficiency and economy dictates that each user or customer cannot be provided with straight line road, water, electrical or sewerage connections to satisfy individual needs. Continuous systems best satisfy both the needs of the individual and the public at large.

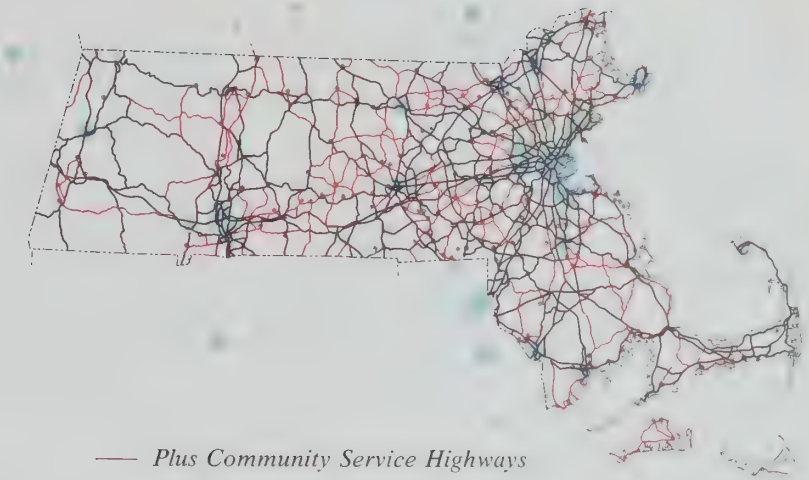
The highest functional class of roads forms a continuous, but limited, system serving points of greatest economic importance. The successive addition of groups of lower functional class roads, to serve centers of decreasing levels of importance, expands the basic network as a complete system.

System continuity within each urban area is of equal significance. Not only must routes of statewide functional importance serve primary traffic generators within the urban area but it is also essential that internal systems be formed to service and connect all other points of traffic interest.

Serve a similar range of trip distances. The connection of the largest population centers of Massachusetts with each other, and similar centers outside the state, provide service to the major corridors of long-distance travel because these centers are generally more remotely spaced. As successive groups of lower functional class roads are added to the network, average trip lengths decrease because of the closer proximity of centers being connected.



— *Plus Collector Highways*



— *Plus Community Service Highways*

Local access roads and streets characteristically serve only short distance door-to-door trips or a portion of a longer trip serviced by an arterial facility.

Serve a similar range of traffic magnitude. Traffic volumes are directly related to the importance of centers connected by a route and the intensity of development along the route. Traffic is heaviest on routes of highest functional class. In general, average traffic volumes decrease as the functional rank of road classes decreases. In Massachusetts, average daily traffic on the highest rural functional road class was found to be about 50 times the average for local rural access roads.

Concentrate traffic service. To concentrate travel within an individual corridor, only one route in each corridor was selected for high functional classification. It is not economically feasible to build all roads to high engineering standards. Improvement of one route tends to concentrate the majority of through travel on the selected road. Conversely, equal classification and improvement of several parallel roads would divide corridor travel among the routes and disperse highway resources. Also, wherever possible—without excessive extra travel distance—trips between lesser centers were assigned to routes of higher functional classified corridors, thereby reducing mileage of the middle functional classes.

Provide area balance. In functional highway classifcation it is essential that each area of the state be treated similarly. For example, the plan developed for the rural portions of Plymouth County in the east must be consistent with the plan for a western county such as Berkshire. Likewise, the plans developed for urban areas, both large and small throughout the state, must be consistent. Spacing criteria, density of population, and route direction are factors influencing consistent balance in area service.

Utilize best developed existing routes. Whenever closely parallel alternative routes were available from which to choose one for a given functional class, the choice was influenced by existing condition and development. The route with definite advantages in terms of curvature, vertical alignment, width or surface condition was given preference if it was not more than 10 percent longer than a shorter, inferior route.

If condition factors of alternative routes were about equal, the choice was influenced by previous decisions regarding jurisdiction or administration.

Thus, the fact that one route was already a state highway or a designated Federal-aid route, gave it preference for higher classification over another route which was not.

Serve committed future development. The functional classification process considered industrial, commercial, recreational and other centers of concentrated economic and social activity that had advanced in planning to the point where development was firmly committed. Likewise, all definitely committed (e.g., unbuilt portions of the Interstate System) roads were considered as existing and functioning in the total public road network. Incorporation of firmly committed future developments into the functional classification plan required adjustments in functional importance of existing roads within the travel corridor served by the new facility.

Designation of Functional Road and Street Classes

The functional classification process was carried out in three phases—statewide, rural areawide and urban.

In the statewide phase five arterial highway classes connect all large Massachusetts population centers and centers of similar importance in bordering states.

The rural areawide phase continues the designation of arterial roads on a regional basis connecting all remaining population centers with each other and with the larger centers included in the statewide plan.

The urban classification phase incorporated extensions of both statewide and rural areawide routes into and through urban areas of over 5,000 population, as well as other internal arterials needed to service and connect focal points of traffic interest within each area.

FUNCTIONAL HIGHWAY CLASSIFICATION PLAN

Functional Class	*Miles*	*Percent*		*Travel Percent*		*Average Daily Traffic*
		Each Group	Cumulative	Each Group	Cumulative	
1. Interstate	453	1.6	—	17.5	—	22,500
2. Principal	898	3.1	4.7	19.8	37.3	12,850
3. Major	915	3.2	7.9	10.7	48.0	6,800
4. Collector	919	3.2	11.1	6.8	54.8	4,250
5. Community Service	1,223	4.2	15.3	5.7	60.5	2,940
6. Regional Arterials	1,849	6.4	21.7	5.1	65.6	1,620
7. Town Arterials	1,967	6.8	28.5	2.6	68.2	760
8. Primary Urban	379	1.3	29.8	6.5	74.7	10,100
9. Secondary Urban	898	3.1	32.9	7.6	82.3	4,925
10. Tertiary Urban	753	2.6	35.5	2.9	85.2	2,250
Total Arterial Classes	10,254	35.5	—	85.2	—	4,850
11. Local Roads and Streets	18,588	64.5	—	14.8	—	465
Total	28,842	100.0	—	100.0	—	2,030

Statewide Highway Classification

The relative importance of Massachusetts' cities and towns was measured in terms of population, manufacturing employment, manufacturing payroll and commercial sales.

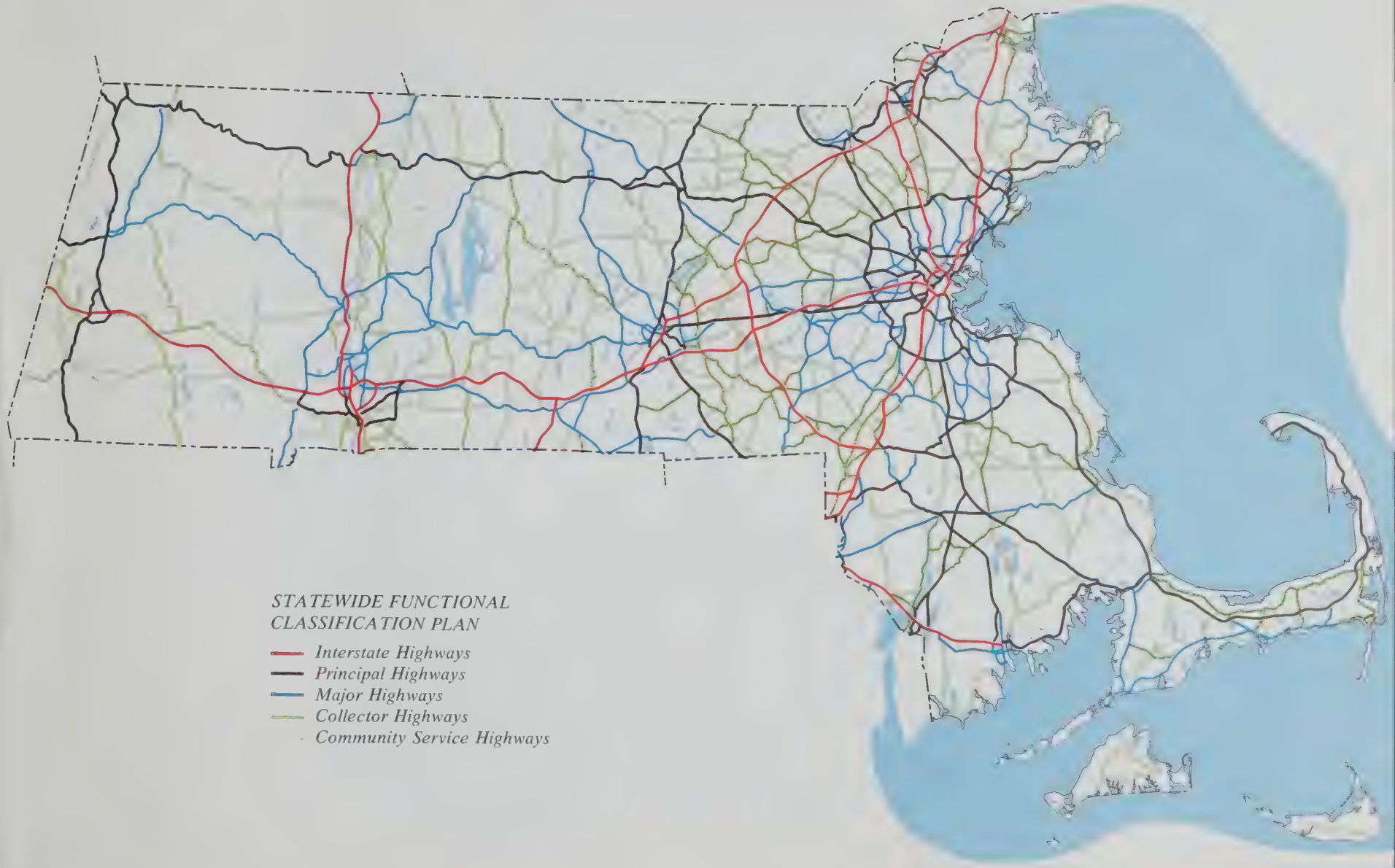
Because a center's population is a basic indicator of its importance, a population rank of cities and towns was initially established and studied. The ranking process revealed significant break points at values of 50,000, 15,000, 4,500 and 1,000 population. Four population groupings were therefore established—50,000 and over, 15,000 to 49,999, 4,500 to 14,999 and 1,000 to 4,499. All places under 1,000 population were excluded from the statewide analysis.

Rankings of cities and towns over 1,000 population by employment, payroll and sales indices were also developed and the initial place groupings adjusted to bring centers of similar total importance more nearly together. Pittsfield, for example, was moved up to the highest grouping because of its high rank in manufacturing sales and manufacturing payroll. Amherst was advanced to reflect the expansion underway at the University of Massachusetts.

The population groupings were also modified to reflect the importance of recreation. State and Federal parks were ranked according to their annual visitors. Cape Cod and the Gloucester-Rockport areas were placed in the highest grouping. Other recreational facilities such as Salisbury State Reservation and private ski resorts were also studied.

Statewide Classes

Interstate Highways formed the highest functional class of roads. The entire Interstate System was classified including unbuilt portions. This nationwide system has a definite plan for financing and a schedule for completion and is considered com-


STATEWIDE FUNCTIONAL
CLASSIFICATION PLAN
Interstate Highways
Principal Highways
Major Highways
Collector Highways
Community Service Highways

mitted to construction. Routes of the Interstate System connect many, but not all, centers in the highest population grouping.

Principal Highways were designated to complete statewide travel service to centers over 50,000 population. Principal Highways connect with routes in surrounding states to provide direct service to all other centers over 50,000 population in the northeastern United States.

The combined Interstate and Principal Highway classes include about five percent of total road and street mileage and carry about 37 percent of all motor vehicle travel in Massachusetts. Traffic on the Interstate Routes averages about 22,500 vehicles per day; on Principal Highways about 12,900 vehicles per day.

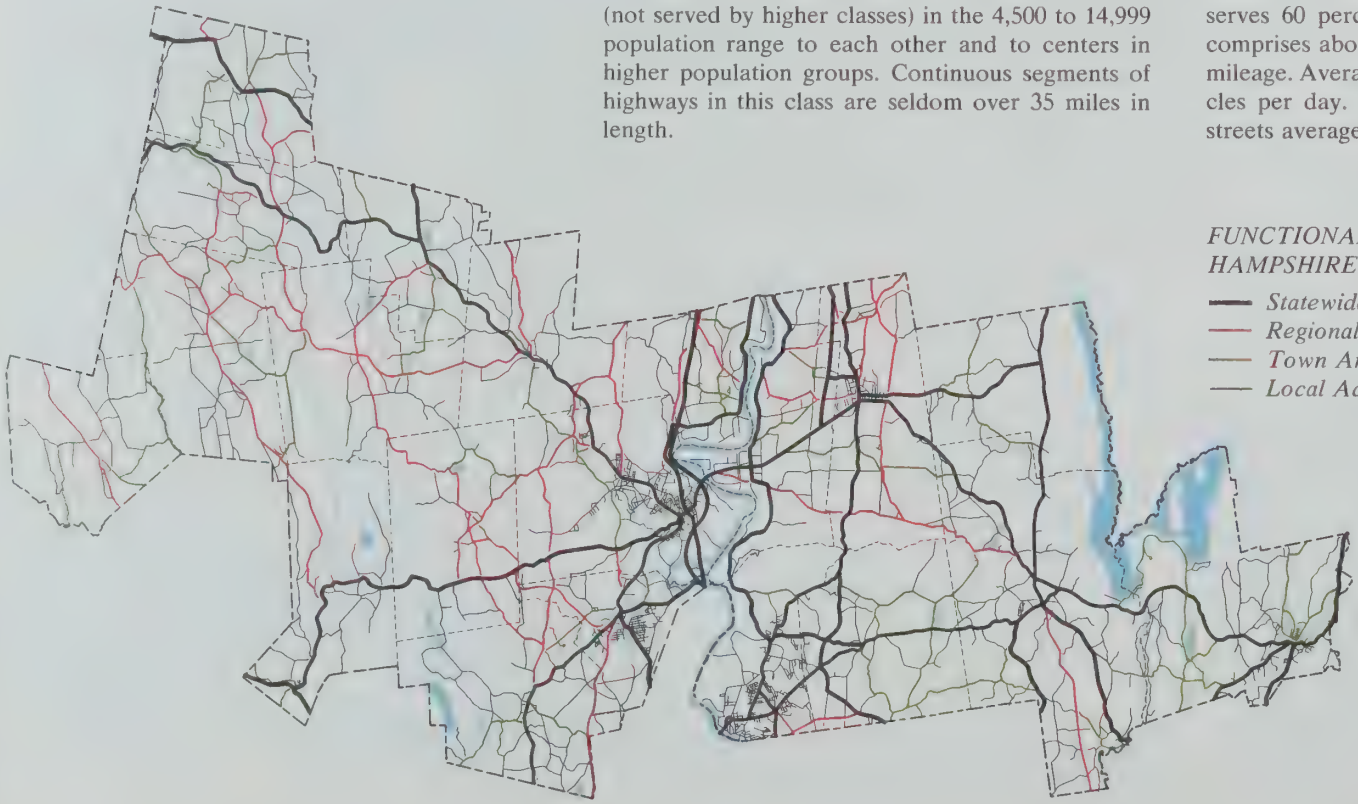
Major Highways connect centers in the second population grouping to each other and to centers of the highest population grouping. Major Highways total 915 miles and carry about 11 percent of all motor vehicle traffic averaging about 6,800 vehicles per day. The combined Interstate, Principal and Major Highways include eight percent of total road and street mileage and serves 48 percent of all vehicular travel.

Collector Highways connect remaining centers (not served by higher classes) in the 4,500 to 14,999 population range to each other and to centers in higher population groups. Continuous segments of highways in this class are seldom over 35 miles in length.

Average daily travel on Collector Highways is approximately one-fifth that on Interstate Highways. The network formed by segments of Collector, and higher classified, Highways is about 11 percent of total public road and street mileage and carries about 55 percent of all motor vehicle travel.

Community Service Highways were designated to connect all remaining centers in the 1,000 to 4,499 population group. Also, all remaining recreational and tourist attractions were served by Community Service Highways. Highways of this class are generally less than 20 miles in continuous length. Average traffic is approximately 2,900 vehicles per day.

The five statewide functional classes combined serves 60 percent of all motor vehicle travel and comprises about 15 percent of total road and street mileage. Average traffic is approximately 8,000 vehicles per day. Traffic on all remaining roads and streets averages about 950 vehicles per day.



FUNCTIONAL CLASSIFICATION PLAN
HAMPSHIRE COUNTY

- *Statewide Functional Highway Classes*
- *Regional Arterial Roads*
- *Town Arterial Roads*
- *Local Access Roads*

Rural Areawide Road Classification

In the rural areawide phase three additional functional classes of roads were designated—Regional Arterial Roads, Town Arterial Roads and Local Access Roads. The two arterial classes primarily connect small rural population centers with the statewide network. They also play an important role in collection and distribution of traffic from and to Local Access Roads.

To select the rural areawide arterial classes, a population rank of centers under 1,000 population was developed and two population groupings, 100 to 1,000 and under 100, established. The smaller centers are little more than clusters of homes usually with a church and a single store. However, they are significant to the rural population as focal points of social and economic activities.

Regional Arterial Roads were selected to connect the larger of the two population groupings with each other and with the arterial system formed by the five statewide functional classes. Except in sparsely settled areas of western Massachusetts, roads of this class are usually under 10 miles in continuous length. Average traffic on Regional Arterial Roads is about 1,600 vehicles per day.

Town Arterial Roads connect into the arterial system the remaining identifiable centers or clusters of rural farms and residences. These roads are primarily significant to the town or towns the roads traverse. Average traffic is about 750 vehicles per day.

Local Access Roads are all remaining roads serving farms and rural residences. Local Access Roads total 9,500 miles or about one-third of the state's total road and street mileage. They serve about five percent of all motor vehicle travel. Traffic averages about 295 vehicles per day.

FUNCTIONAL CLASSIFICATION PLAN
CITY OF NORTHAMPTON

- *Statewide Functional Highway Classes*
- *Regional Arterial Roads*
- *Town Arterial Roads*
- *Secondary Urban Arterial Streets*
- *Tertiary Urban Arterial Streets*
- *Local Access Streets*

Urban Street Classification

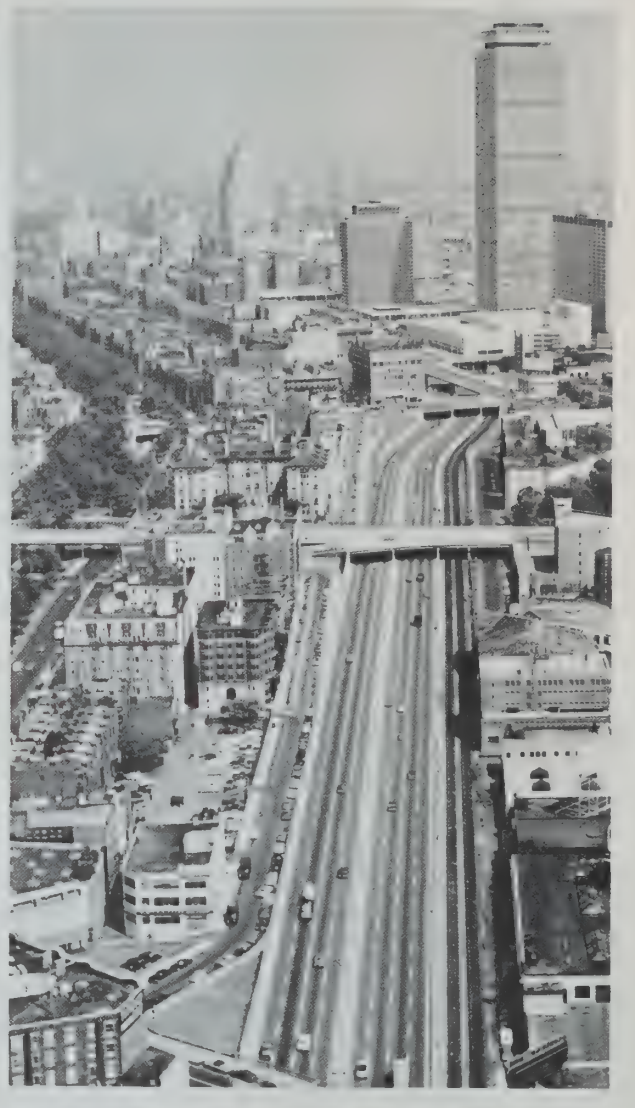
Each urban area over 5,000 population was examined and a functional classification plan developed for it. Focal points of traffic generation were identified through study of aerial photographs, master street plans, land use plans, planning reports and data from comprehensive urban transportation studies. In the Boston and Springfield urbanized areas the identified centers of traffic generation were classified into three groupings of descending importance—principal, primary and secondary. In all other urban areas of the state, centers were classified as primary or secondary importance.

The principal traffic generators in the Boston and Springfield areas are served by the first two statewide functional highway classes. Some primary and secondary traffic generators are also served by urban extensions of other functional highway classes selected in the statewide and rural areawide phases of the classification process.

Three urban classes of arterial streets and highways along with a fourth class of local access streets were designated in each urban area. The three urban arterial classes expand the network formed by the urban segments of statewide and rural areawide functional classes.

Primary Arterial Streets serve the main internal urban travel corridors not served by statewide arterial highways. They connect into the combined statewide classes all other primary generators of urban traffic. Primary centers include large shopping centers, large individual industrial plants, colleges, etc. Generally, the urban Primary Arterial Streets include all the higher traffic volume streets, except those handling short trips or streets serving as alternates to more direct facilities. Primary Arterial Streets total 379 miles, or 1.3 percent of total network mileage but serve 6.5 percent of all travel. Average traffic is 10,100 vehicles per day.

Secondary Arterial Streets serve the less concentrated traffic generating centers such as neighbor-



The operations of business, trade and agriculture as well as the basic habits of family living revolve around highway service and the availability of adequate road and street systems.

hood shopping centers, high schools, small industries, etc. This class distributes medium traffic volumes to and from the higher class urban and statewide arterial streets and highways. They total 898 miles and carry an average traffic of about 4,900 vehicles per day.

Tertiary Arterial Streets serve to collect traffic from Local Access Streets and feed it to higher class arterial streets. Tertiary Arterial Streets are usually about one mile in length and were selected to focus traffic in and out of residential neighborhoods. Traffic averages 2,250 vehicles per day.

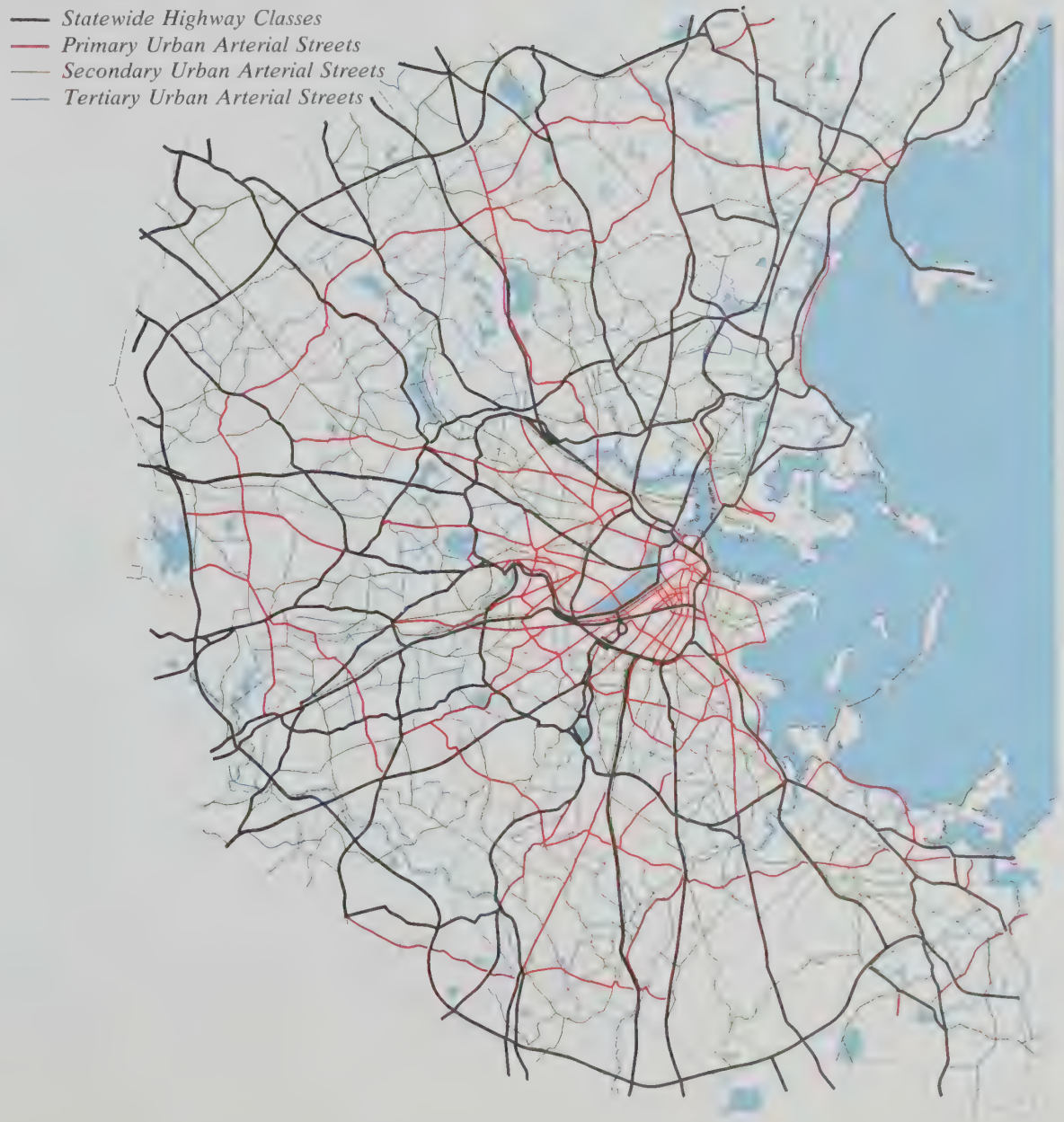
Local Access Streets are streets not selected for inclusion with any of the urban arterial classes. They provide access to individual homes and shops and other minor traffic destinations. Access Streets total about 9,100 miles and carry an average traffic of approximately 650 vehicles per day.

Review Process

The initial groupings of roads and streets by functional class were made by study staff in accordance with established procedures and guiding criteria. Maps were prepared showing roads and streets in each grouping. These maps and supporting information were reviewed by Department of Public Works District Highway Engineers and their staffs. Also each city and town was invited to participate in a series of meetings held across the state.

At each meeting maps showing the functional classification plan were provided the mayors, city councilmen, selectmen, planning commission members, traffic engineers, public works superintendents and road supervisors in attendance. Staff explained the basis of initial decisions. Pertinent facts not previously known were considered. Special local problems were taken into account. Comments and suggestions raised by the reviews that were consistent with established criteria and guidelines were incorporated into the functional classification plan.

FUNCTIONAL CLASSIFICATION PLAN
BOSTON METROPOLITAN AREA



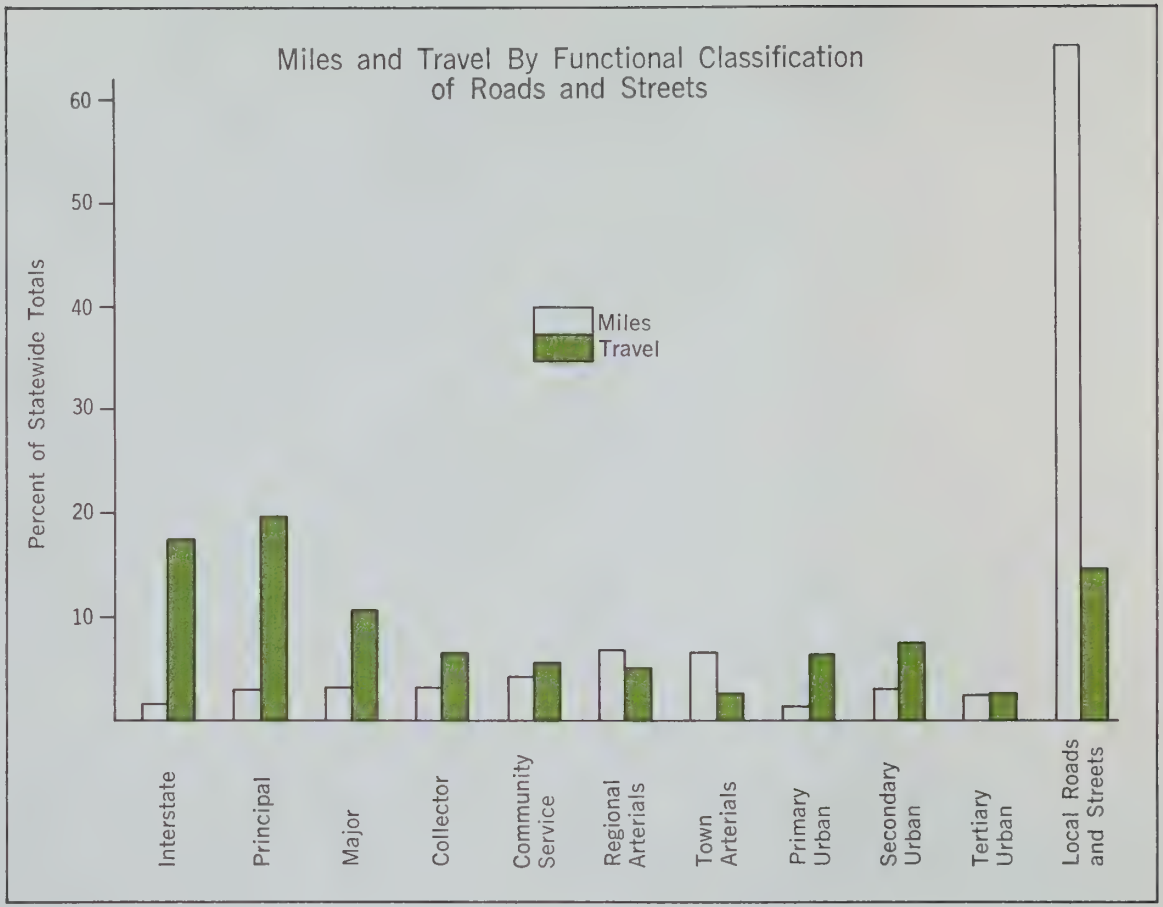
Approximately 80 percent of the 351 cities and towns were represented at the review meetings. Department District Engineers later held individual reviews with the remaining muncipalities to secure their reactions and comments. Reception by city and town officials of the study concepts and the functional classification plan was excellent.

Functional Classification Plan

The table on page 18 shows the miles of roads and streets grouped in each functional class and a percentage distribution of total statewide travel for each grouping. In total, arterial functional classes represent 35.5 percent of the road and street network and serve 85.2 percent of all motor vehicle travel. Local roads and streets comprise 64.5 percent of total mileage and carry 14.8 percent of total travel.

Routes comprising the five statewide functional classes are shown on the map on page 19. Maps on pages 20 and 21 show the total functional classification plan for Hampshire County and the city of Northampton, respectively. Individual maps for each city and town are available in the study files of the Department of Public Works.

The groupings of roads and streets by functional characteristics as developed for this analysis provided a firm basis for the determination of present and future physical road and street needs and costs carried out as a separate, but related, phase of the total Statewide Highway Transportation Study. Of equal importance they provide a rational base for reassignment of road and street responsibilities among levels of government as recommended in Chapter III.



CHAPTER III
ASSIGNING RESPONSIBILITIES

The problems surrounding present day management of road and street affairs in Massachusetts result from an evolutionary process extending back over many years. A logical plan for firmly assigning road and street responsibilities among levels of government is essential for improved highway development and intergovernmental relations.

The Interstate System was selected under Federal policy and specific goals established for its development. So too, can Massachusetts designate road and street systems defined by function and purpose, assign jurisdictional responsibilities and set development goals.

Since the turn of the century, administration of road and street affairs in Massachusetts has been primarily the responsibility of the state and municipal governments. Counties have not been a major factor, as in most states. Consolidation of municipal road affairs, particularly those of the smaller municipalities, under county or regional supervision, would make possible greater economy and efficiency. However, to do this would require creation of operating highway organizations. Providing competent staff, adequately equipped, and overcoming the difficult legislative and administrative problems to establish effective working highway departments would require a long time. While the problems of implementation would be difficult they are possible of eventual solution.

For the near-term future however, road and street affairs must remain the responsibility of the state and municipalities. But reassignment of existing responsibilities is urgently needed. Clearly, highways as vital to the economy of the nation and Massachusetts as the Interstate System must be the responsibility of state government. Most cities and towns could not gear their engineering forces to construct this type of facility. Nor should cities and towns be responsible for facilities serving traffic that is almost wholly passing through them.

On the other hand, roads and streets that serve predominantly as access to residences and farms clearly should be local responsibility. Local authorities are in a far better position for prompt and responsive actions to local needs than state government.

Between these two extremes, state responsibility logically proceeds down the functional classification hierarchy and municipal responsibility proceeds upward. A number of alternative arrangements for assigning jurisdictional responsibility of the intermediate functional classes of arterials were studied. The recommended plan is best suited to Massachusetts conditions and most practical of achievement. It must be related, however, to the recommendations of the companion fiscal study, reported separately.

Recommended Systems Plan

The recommended plan proposes establishment of five administrative systems of state-owned and municipally owned roads and streets. The extent of each system and proposed jurisdictional responsibilities are shown in the table on page 27. Uniformity in the functional character of routes comprising each system would provide the consistency, now lacking, in levels of service to all parts of the state.

The five recommended administrative systems do not include 423 miles of roads and streets which, for various reasons, should remain under the jurisdiction of agencies presently responsible for them. These include toll facilities operated by the Turnpike Authority and the Port Authority, roads administered by the Metropolitan District Commission (with the exception of ones forming segments of statewide arterial routes) and a limited mileage of public roads within Federal, state and local reservations.

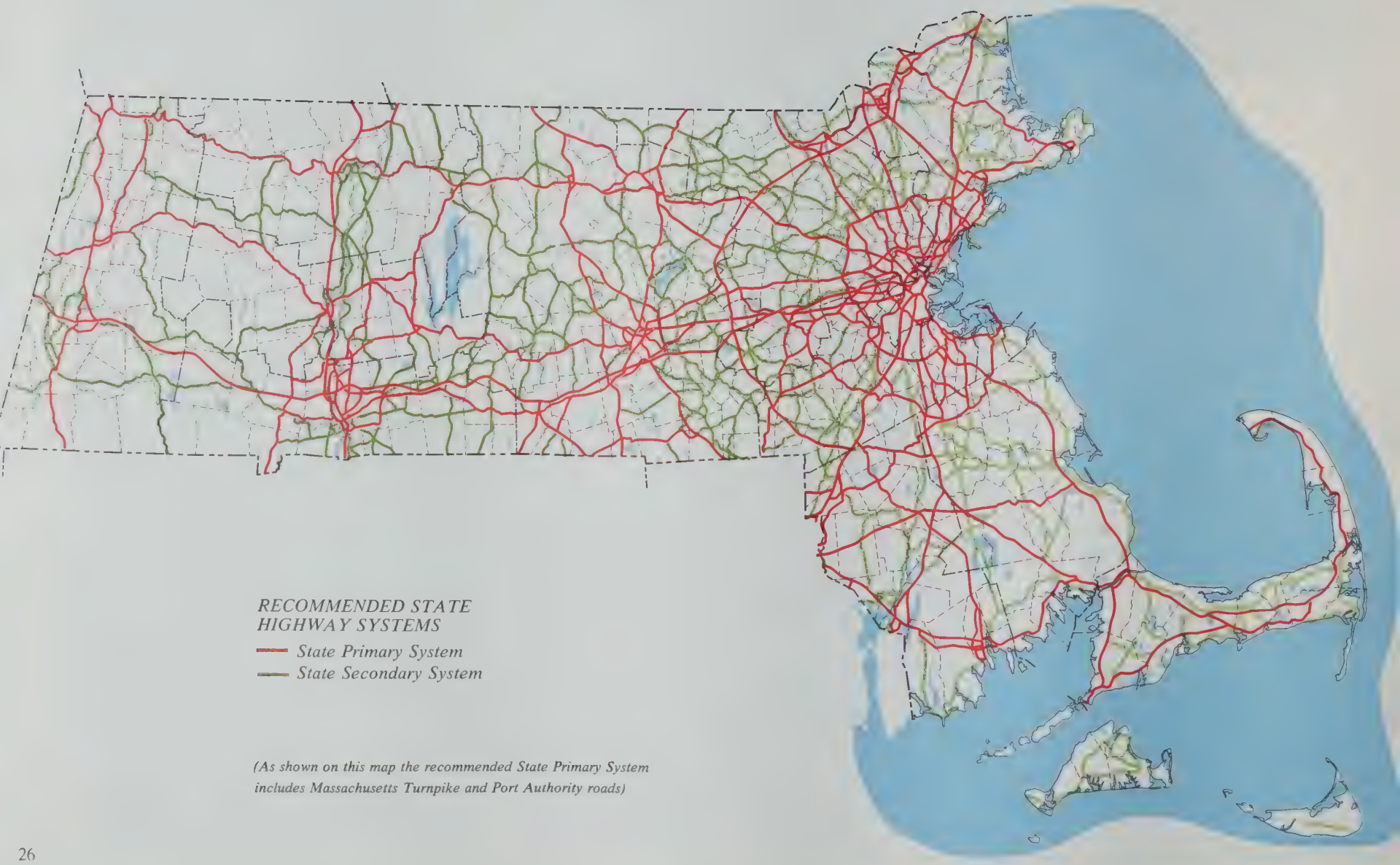
State Responsibility

Two systems of state-owned roads identified as a State Primary System and a State Secondary System should be established. Both systems, including the urban portions thereof, should be the sole responsibility of the Department of Public Works.

The proposed State Primary System, totalling 2,125 miles, is composed of the first three statewide functional classes of roads and streets, as listed in the table on page 18, excepting 141 miles of toll facilities presently administered by the Turnpike Authority and the Port Authority. While representing only 7.4 percent of total network mileage, the proposed State Primary System would serve 43.7 percent of all motor vehicle travel in the state. Traffic averages 12,000 vehicles per day. It serves all cities and all other economic centers in the state of over 15,000 population.

The proposed State Secondary System consists of the fourth and fifth functional classes of roads and streets as listed in the table on page 18. This system totals 2,142 miles. Representing 7.4 percent of total network mileage, it accommodates 12.5 percent of all travel. Traffic averages 3,500 vehicles per day.

Together the proposed State Primary and State Secondary Systems connect all places in Massachusetts of 1,000 population and over. Approximately 83 percent of the state's total population and 98 percent of its major industrial plants are located



(As shown on this map the recommended State Primary System includes Massachusetts Turnpike and Port Authority roads)

within one mile of routes of the combined systems. Major industrial plants are those employing over 100 persons.

In total, the recommended plan would place 14.8 percent of all public road and street mileage under state control. In the 48 contiguous states, 25 state highway departments control less than 15 percent of all mileage, and 23 have more. The recommended plan provides an equity in state highway responsibility between rural and urban areas that now is lacking. It concentrates state responsibility on those roads and streets carrying most traffic of statewide interest and most essential to all the people.

Combined, the proposed state systems, totaling 4,267 miles, includes 2,284 miles of existing and committed state highways, 386 miles of existing city streets, 1,551 miles of existing town roads and 46 miles of roads under the jurisdiction of the Metropolitan District Commission and other agencies. Excluded are 404 miles of existing state highways not meeting functional service characteristics of routes included in the proposed state systems.

City and Town Responsibility

The recommended classification plan proposes three administrative systems of municipally owned roads and streets. Design standards appropriate to the service requirements of each system should be established and suitable financial policies determined.

The proposed Major Arterial System totals 3,050 miles in all municipalities, representing 10.6 percent of total network mileage and serving 18.6 percent of all travel. Average traffic is 3,560 vehicles per day. In rural towns this system connects centers of 100 to 1,000 population with each other and with routes of the proposed State Primary and Secondary Systems. In urban towns and cities Major Arterials serve the primary and secondary focal points of traffic concentration, as identified in the functional classification analysis, and connect with the urban portions of the proposed state systems.

The proposed Minor Arterial System connects centers of under 100 population in rural towns and the functionally classified tertiary arterials in urban towns and cities with the three administrative systems recommended above. This system totals 2,703 miles, or 9.4 percent of total network mileage. It serves 5.4 percent of all motor vehicle travel. Traffic averages about 1,160 vehicles per day.

The proposed Local Access System is composed of all roads and streets not included in one of the arterial functional groupings, with the exception of 189 miles of access roads within Federal, state and local reservations. Statewide, the Local Access System totals 18,399 miles or 63.7 percent of the total public road and street network.

Combined, the three proposed municipally owned road and street systems, totaling 24,152 miles, consist of 23,748 miles of existing town roads and city streets plus 404 miles of existing state highways not meeting service characteristics of routes included in the proposed State Primary and Secondary Systems.

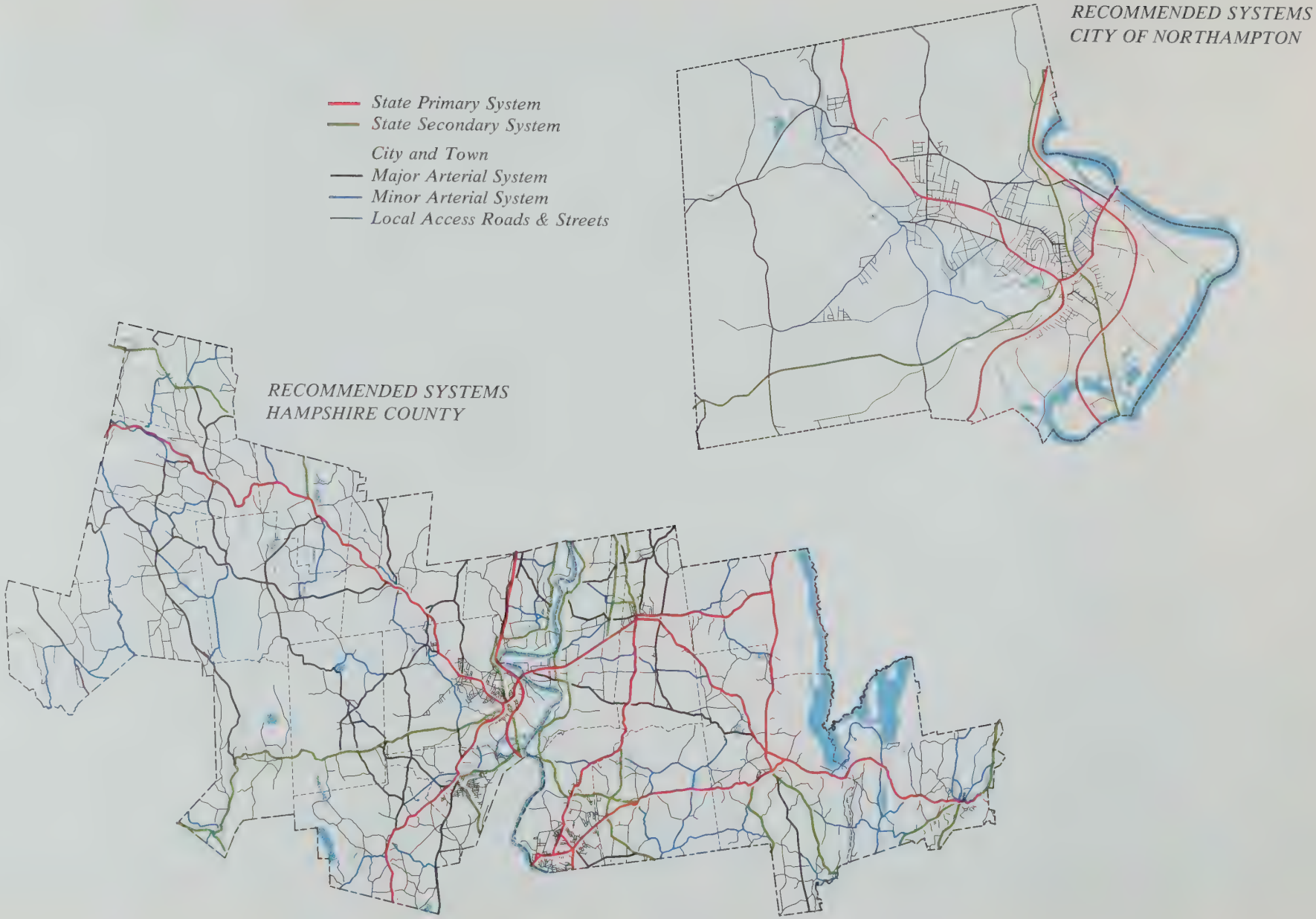
Responsibility for Other Roads

The 141 miles of toll facilities administered by the Massachusetts Turnpike Authority and the Massachusetts Port Authority should remain under their present jurisdictions, at least until outstanding revenue bonds issued for construction have been retired. Since these toll facilities are part of the functional groupings of Interstate and principal highways they could logically, after bond retirement, be transferred to the proposed State Primary System as a responsibility of the Department of Public Works.

Under the recommended plan, those Metropolitan District Commission roads which are segments of routes of statewide arterial significance are incorporated into the proposed State Primary and Secondary Systems. Other existing MDC roads totaling 107 miles should, for the short range future, remain the responsibility of that agency. However, 79 miles of these roads function primarily as urban arterials

RECOMMENDED SYSTEMS PLAN

Ownership, System and Class	*Miles*	*Percent*	
		Total Miles	Total Travel
State Ownership			
Primary System			
Interstate	318	1.1	13.3
Principal	892	3.1	19.7
Major	915	3.2	10.7
Subtotal Primary System	2,125	7.4	43.7
Secondary System			
Collector	919	3.2	6.8
Community Service	1,223	4.2	5.7
Subtotal Secondary System	2,142	7.4	12.5
Total State-Owned	4,267	14.8	56.2
City and Town Ownership			
Major Arterial System			
Primary Urban Arterials	345	1.2	6.1
Secondary Urban Arterials	868	3.0	7.4
Regional Arterials	1,837	6.4	5.1
Subtotal Major Arterial System	3,050	10.6	18.6
Minor Arterial System			
Tertiary Urban Arterials	745	2.6	2.9
Town Arterials	1,958	6.8	2.5
Subtotal Minor Arterial System	2,703	9.4	5.4
Local Access System	18,399	63.7	14.8
Total Municipal-Owned	24,152	83.7	38.8
Other Roads and Streets	423	1.5	5.0
	28,842	100.0	100.0


State Primary System
State Secondary System
City and Town
Major Arterial System
Minor Arterial System
Local Access Roads & Streets
RECOMMENDED SYSTEMS
CITY OF NORTHAMPTON
RECOMMENDED SYSTEMS
HAMPSHIRE COUNTY

and should ultimately be transferred to city and town jurisdiction as part of the recommended Major and Minor Arterial Systems. This would leave the Metropolitan District Commission responsible only for access and service roads within park lands.

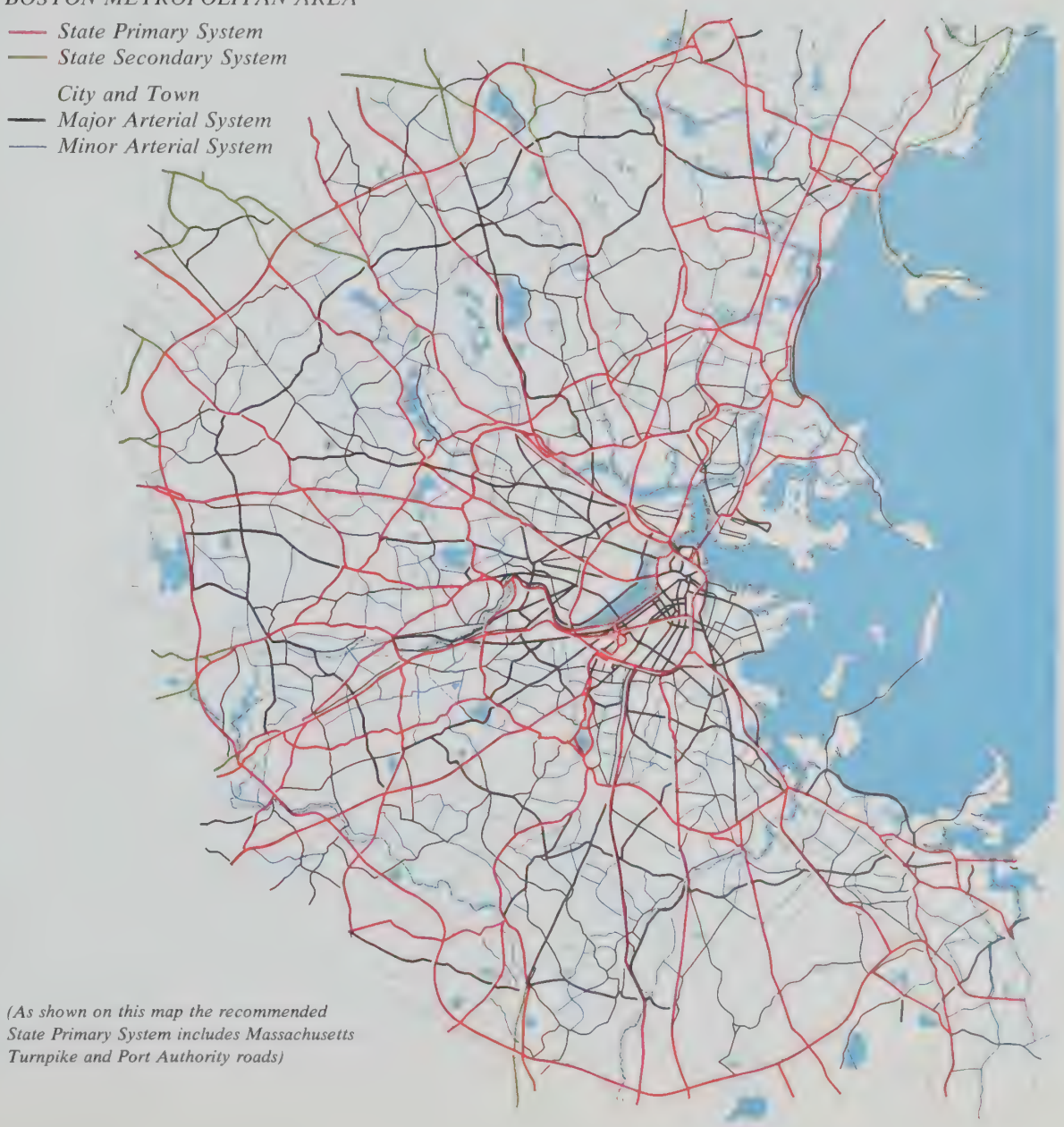
Existing responsibilities for construction and maintenance of 175 miles of public roads within federal and state parks, state forests, and state and county institutions should remain unchanged. Only 14 miles of these roads have an arterial function. The remainder are access roads. However, since they are all located on public lands they should not logically be included in the proposed municipally owned road and street systems.

Reasons for Recommended Plan

The recommended classification plan provides a rational and logical division of road and street responsibilities among levels of government. It brings together, as separate administrative systems, roads and streets of similar service characteristics requiring the same degree of technical competence in their design, construction, maintenance and operation. It assigns responsibility for each system to the level of government having the greatest basic interest therein. It provides a basis for efficient management and intergovernmental coordination of road and street affairs which minimizes conflicts between governmental units. It forms a base to which finance policies can be related with definite promise of accelerated and orderly development of the state's road and street network.

Establishment of the recommended State Primary and Secondary Systems, clearly defined as to character and extent, as the sole responsibility of the Department of Public Works will give all jurisdictions a firm foundation to plan for future road development. At present, responsibility for the 4,267 miles of roads and streets comprising the recommended state systems is shared by the Department and 247 cities and towns. This fragmentation of responsibility is contrary to accepted principles of

RECOMMENDED ARTERIAL SYSTEMS
BOSTON METROPOLITAN AREA



(As shown on this map the recommended State Primary System includes Massachusetts Turnpike and Port Authority roads)

good management and is not in the public interest. With state control of routes of statewide importance, municipalities can concentrate resources on development of roads and streets of regional and local importance.

The recommended systems plan would transfer from municipal to state responsibility an average of about 4.5 miles of road or street for each city and town. Traditionally, Massachusetts municipalities have held to the principle of "home rule" in local affairs. The adjustments in responsibility proposed do not violate the "home rule" concept. The roads and streets involved are segments of statewide arterials carrying more through traffic than local.

As an aid to improved long-range planning and programing, identity of the several functional classes of roads and streets comprising each of the recommended state-owned and municipally owned arterial systems should be maintained. Basic principles of priority programing (of which functional classification of roads and streets is a key factor) are discussed later, on this page . Also the functional classes are the base for establishing design, maintenance and operation standards related to levels-of-service requirements for each class. The more important classes—the Interstate System being a good example—should have higher service levels and standards than the lesser classes.

Federal-aid Systems

Existing Federal-aid highway systems should be modified to make possible more orderly utilization of the various classes of Federal-aid funds under the recommended classification plan. The several Federal systems have been designated over the years under general policies and regulations of the Bureau of Public Roads. However, the existing systems are not related to present state and municipal responsibilities nor the reassignment of such responsibilities proposed under the recommended systems plan.

To provide improved planning and systems development the Department of Public Works should initiate actions to:

1. Adjust the Federal-aid Primary System to coincide with the recommended State Primary System, and
2. Expand and adjust the Federal-aid Secondary System to coincide with the recommended State Secondary and city and town Major Arterial Systems.

The adjustments in Federal systems necessary to accomplish these objectives can be accomplished by administrative actions of the Department and the Bureau of Public Roads. While providing no additional Federal funds to Massachusetts, coincident systems would facilitate fiscal planning and simplify management problems.

Coordination of Road and Street Management

The assigned responsibilities for the three proposed municipally owned road and street systems must be firmly coupled with a suitable financial policy established by the General Court. The finance plan should continue to involve state aid funds, proportionate to the degree of state interest in each municipal system determined equitable by the companion study of fiscal policies and requirements, reported separately.

State government has a public obligation to make sure that maximum benefits are obtained from state aid funds. In those states where state aid programs are carried out most efficiently the state-local relationship is patterned in principle after the Federal-state highway relationship which has operated successfully for over 50 years.

With 351 cities and towns sharing responsibility for development of the recommended municipal road and street systems, effective coordination of management and engineering activities is imperative for orderly integrated progress and optimum use of financial resources. Especially is this necessary for the proposed Major and Minor Arterial Systems.

The Department of Public Works, as the principal highway authority of the state, is the logical agency to coordinate road and street management on a statewide basis. Such coordination should be directed toward achievement of sound objectives and not to control of the day-to-day operations of local highway agencies. Cities and towns should operate autonomously within guidelines established for planned orderly system development.

In establishing the revised state aid finance policy the General Court should direct the Department to:

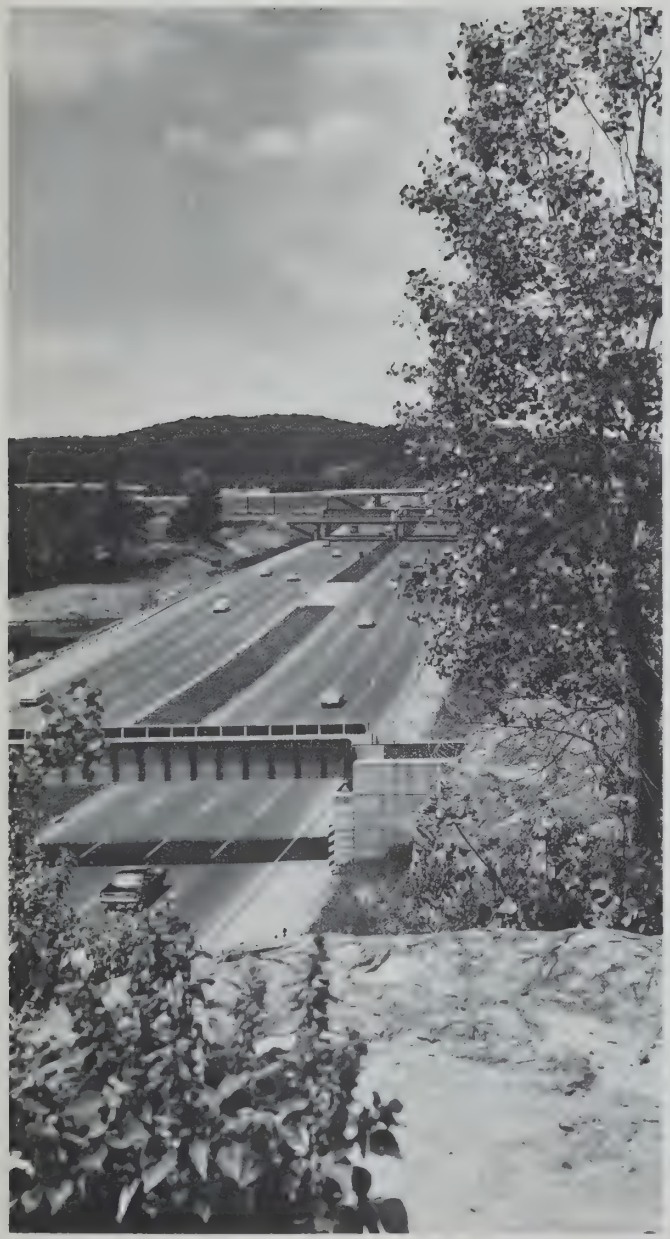
1. Assist cities and towns in designating recommended Major and Minor Arterial Systems.
2. Cooperate with local road and street officials in developing uniform design standards and construction practices.
3. Review and approve annual improvement programs to be financed with state aid funds.
4. Assist municipalities in developing desirable standards and procedures for road and street maintenance.
5. Foster and encourage improvement of road and street management, particularly the technical function which, to be carried out effectively, requires engineering direction.

To provide the increased leadership and guidance necessary for effective coordination of municipal road and street development will require strengthening and upgrading of the Department's existing State Aid Section both in headquarters and in the field districts.

At least biennially the Department should report to the General Court on the status of municipal arterial road and street development, the use of state aid funds and recommendations for needed legislation.

Priority Programing

Priority programing for highway development is a process for rational selection of construction projects based on relative urgency, systematically scheduled within limits of available resources to carry out legislative and administrative objectives for system



Highway classification is the orderly grouping of roads and streets into systems by levels of service. It is the means for clearly and consistently defining responsibilities among the several levels of government in balance with firm and equitable finance plans.

development. The principles involved are applicable to construction programs of all highway agencies.

Goals for development of each of the recommended administrative road and street systems should be to obtain greatest benefits from available revenues. In general, this means providing for faster rates of construction on the more important roads and streets while at the same time taking care of essential requirements on lesser classes. To accomplish this there must be firm budgeting of funds for each administrative system and for each functional class. Budget allocations should be based on relative needs, proportion of travel served, degree of acceleration deemed desirable for the more important functional classes of roads and streets, policies for area distribution of funds and similar factors.

With firm budget allocations determined, priority programing involves establishment of systematic engineering analysis procedures for evaluating relative urgency of all needed improvements by functional class of roads and streets. Just as all roads and streets are not of equal functional importance, all needs are not of equal urgency. Determinations of relative urgency of needed improvements and the establishment of priority arrays requires the evaluation of each project as to:

- its structural condition and ability to carry loads imposed upon it
- its capacity to move traffic at reasonable speeds without undue congestion
- its adequacy of alignment, both vertical and horizontal
- its adequacy of roadway and pavement widths, and
- its accident experience

Each type of deficiency must be rated separately to identify all critically inadequate conditions. The ratings provide the basic engineering data for project comparisons and for developing priority arrays of improvements for each functional class in order of relative urgency.

Based on the priority arrays six-year advance construction programs should be developed, by functional class, officially adopted and published.

Finally, effective priority programing requires establishment of a continuous project scheduling, review and control process to insure optimum use of available funds and manpower and to permit program adjustments as necessary to meet changing conditions and unforeseen emergencies.

Priority programing for highway development, in the sense described here is not being done now in Massachusetts. Firm long-range objectives for system development are needed and fiscal policies should be related to needs and road and street responsibilities.

The General Court should require adoption of priority programing, by functional class, by the Department of Public Works in the formulation of construction programs. The principles involved are sound and have produced practical and beneficial results. In states where priority programing is used it has resulted in a high degree of public support and confidence.

Other Arrangements Studied

In arriving at the recommended plan for assigning system responsibilities to state and municipal governments, other possible arrangements were studied and rejected as being less desirable under the circumstances prevailing in Massachusetts. These other possibilities included:

Minimum State Highway System. This alternative was based on a State Highway System composed of the first four functional classes of highways as listed in the table on page 18, exclusive of toll facilities now administered by the Turnpike and Port Authorities. Under this arrangement state responsibility would total 3,044 miles, representing 10.6 percent of all public road and street mileage. It would concentrate state responsibility on the routes of greatest importance to the state and would minimize state responsibility in local problems.

All remaining functional classes of arterial roads and streets would be municipal responsibility comprising a Major Arterial System of 4,269 miles and a Minor Arterial System of 2,703 miles. Responsibility for local access roads and streets would be the same as under the recommended plan.

The State Highway System, under this plan, would include 1,926 miles of existing state highways, 339 miles of existing city streets, 737 miles of existing town roads and 42 miles of MDC roads. It would require transfer of 762 miles of existing state highways to city and town responsibility.

While the net effect would be to increase state responsibility by 356 miles, experience elsewhere has shown that the transfer of large mileages of roads and streets from state to local jurisdiction is difficult to accomplish. Also most of the 762 miles of existing state highways which would be returned to municipal jurisdiction are located in the smaller, rural towns. Many such towns are experiencing difficulties in meeting existing road responsibilities and could not adequately provide essential services on the increased mileage.

This plan would merit serious consideration if effective county highway departments existed in Massachusetts. The Major Arterial System, except in cities and the largest urban towns, could then be a county responsibility similar to county arterial systems in other states. It is a desirable long-range objective predicated on establishment of strong county highway organizations but is not deemed a practical plan under existing circumstances.

Maximum State Responsibility. Another alternate evaluated assigned responsibility to the state for the first six functional classes of roads and streets listed in the table on page 18, exclusive of the Turnpike and Port Authority toll facilities. Under this plan state responsibility would total 6,116 miles or about 21.2 percent of total mileage. Two state systems would be established—a Primary System identical with the recommended plan and a Secondary

System of 3,991 miles. Combined, the two systems would serve all places throughout the state of over 100 population. It would result in a net increase of 3,428 miles in state responsibility.

The concentration of responsibility, under this arrangement, at state level would produce operational efficiencies in equipment utilization, road and street maintenance and management. On the other hand, it would downgrade road and street responsibility and autonomy at municipal level.

The increased state responsibility consists of roads serving communities in the 100-1,000 population range. Problems on such roads which might be of high importance locally frequently would have relatively low priority on a statewide basis.

The weakening of local governments by unduly reducing responsibilities to which they can be most responsive is contrary to the traditional and effective American system of government. Consequently this alternative plan was discarded.

The status quo. This is not a plan. It is an uncontrolled division of responsibilities without planned objectives. Continuation of the existing division of responsibilities would only perpetuate existing inadequacies in highway, road and street management. The Department of Public Works would still be responsible for a substantial mileage of roads of local importance only. At the same time, cities, towns and the Metropolitan District Commission would have responsibility for many segments of road and streets serving traffic of statewide interest. Continuity of route development and uniformity in levels of maintenance and traffic operations would be difficult, if not impossible, to achieve.

The advantages of the recommended plan are immeasurably greater than maintaining the status quo.

Recommended Actions

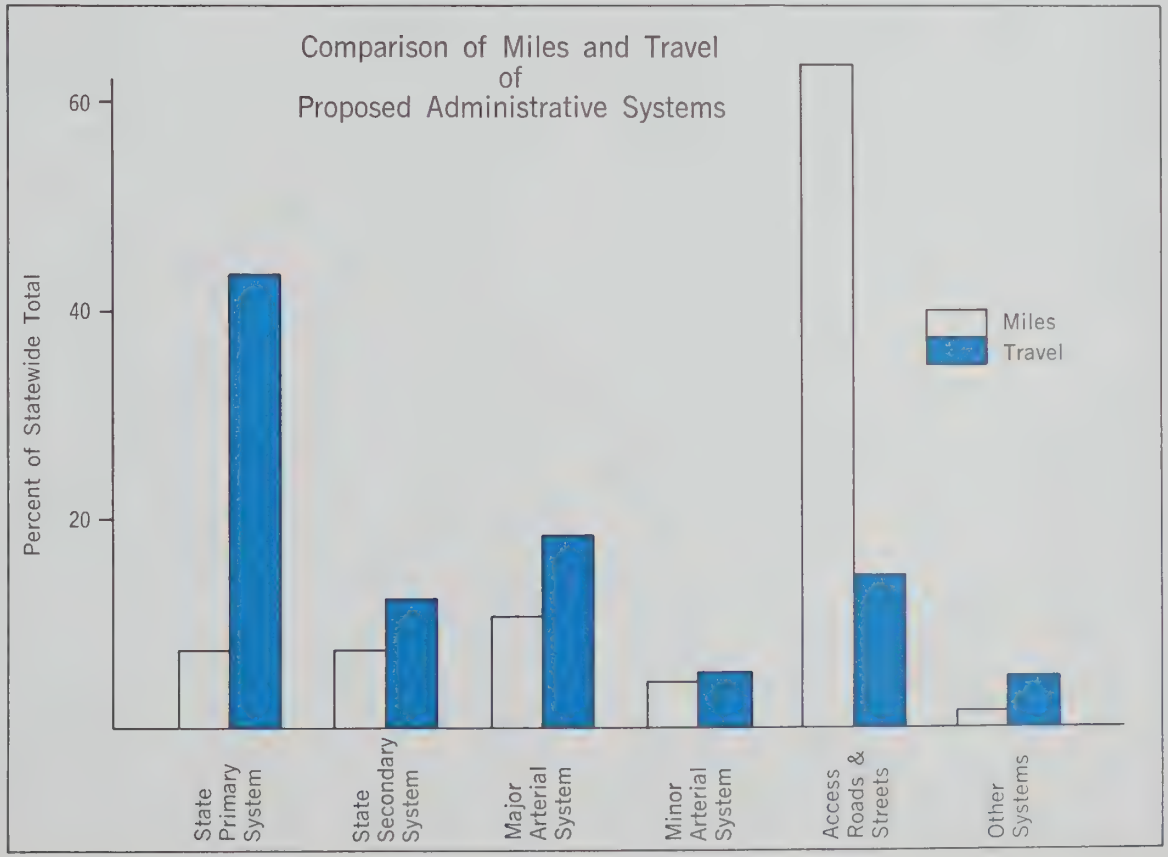
Both legislative and administrative actions are required to realize the benefits of the recommended plan. The proposed administrative systems should be established in line with the principles discussed in the report. The identity of the functional classes of roads and streets comprising each system should be maintained.

The four recommended arterial systems initially should consist essentially of the routes selected in this study. Once established the four arterial systems should remain relatively stable.

The Department should organize for a continuing review and evaluation of functional road and street classification as well as the companion needs and fiscal phases of the total statewide highway transportation study. Changes and additions to the arterial systems should be based on emerging conditions or developments not existing at the time of original designation.

To implement the recommended classification plan, the General Court should:

- Enact a declaration of legislative intent setting forth the need for consistent, stable road and street systems assigned to appropriate levels of



government and related to equitable fiscal plans.

- Direct the Department of Public Works to designate a State Primary System of not to exceed 2,300 miles meeting the criteria established in this study for the functional groups identified as Interstate, principal and major highways. The Department should be required to divide the State Primary System into the three named functional classes for administrative and management purposes and to limit principal highways to 1,000 miles. Sole responsibility for both rural and urban portions of the State Primary System should be assigned to the Department.
- Direct the Department of Public Works to designate a State Secondary System of not to exceed 2,500 miles meeting the definitions previously set forth for the functional groups identified as collector and community service highways. Complete responsibility for the State Secondary System, rural and urban, should be assigned to the Department. The General Court should require division of the system into the two named functional classes and limit the mileage designated as collector highways to 1,000 miles.
- Establish a firm state fiscal plan for balanced development of the State Primary and State Secondary Systems based on findings of the companion needs and finance studies reported separately.
- Require designation of municipally owned Major Arterial Systems totaling not to exceed 3,400 miles statewide and municipally owned Minor Arterial Systems totaling not to exceed 2,800 miles statewide. Routes comprising the Major Arterial System should meet criteria establish in this study for regional, primary urban and secondary urban arterials. Routes comprising the Minor Arterial System should meet criteria established for town and tertiary arterials. Initial selection of routes comprising the Major and Minor Arterial Systems should be by the municipalities following the principles set forth in Chapter II. However, since it is essential that the municipally owned arterial systems be integrated with the State Primary and State Secondary Systems and since there may be problems of stabilization and coordination between municipalities, responsibility for review and final approval of the Major and Minor Arterial Systems should be delegated to the Department of Public Works.
- Make provision for state aid assistance in development and maintenance of municipal roads and streets consistent with recommendations of the separate finance study. State aid funds should be subject to administrative and policy controls by the Department of Public Works as discussed on page 30.
- Require the Department of Public Works within two years, to develop and adopt a factual systematic priority programming process. The process should serve as the basis for preparation of separate six-year advance construction programs for each system and functional class. The advance construction programs should be published and updated at least every biennium to keep planning at least six years ahead of development.

When the State Primary, State Secondary and Major Arterial Systems have been designated, it is recommended that the Department of Public Works and the Bureau of Public Roads take joint action to:

- Redesignate the Federal-aid Primary System to coincide with the State Primary System, and
- Adjust and expand the Federal-aid Secondary System to coincide with the State Secondary and Major Arterial Systems combined.

This will permit more orderly fiscal planning and program development and will facilitate administrative management.

Conclusion

Massachusetts should start now to reorganize road and street responsibilities to provide improved services and management and to handle more efficiently the enlarged highway programs of the future. The recommendations set forth in this report, and the companion study reports, constitute a sound basis for reshaping the highway function in Massachusetts to obtain maximum benefits from highway expenditures.

Access roads and streets comprise about two thirds of the state's public road network. Their primary function is to provide access to farms, residences and other minor traffic generators.

Functional Classification Plan

Miles and Travel by Functional Class and Federal-Aid Rural and Urban Areas

Class	*Federal-Aid Rural*			*Federal-Aid Urban*			*Total*		
	Miles	Percent	Travel Percent	Miles	Percent	Travel Percent	Miles	Percent	Travel Percent
1. Interstate	235	0.8	6.3	218	0.8	11.2	453	1.6	17.5
2. Principal	396	1.4	4.6	502	1.7	15.2	898	3.1	19.8
3. Major	468	1.6	3.4	447	1.6	7.3	915	3.2	10.7
4. Collector	631	2.2	3.4	288	1.0	3.4	919	3.2	6.8
5. Community Service	1,003	3.5	3.7	220	0.7	2.0	1,223	4.2	5.7
6. Regional Arterials	1,572	5.4	3.7	277	1.0	1.4	1,849	6.4	5.1
7. Town Arterials	1,660	5.7	1.8	307	1.1	0.8	1,967	6.8	2.6
8. Primary Urban	7	—	0.1	372	1.3	6.4	379	1.3	6.5
9. Secondary Urban	52	0.2	0.2	846	2.9	7.4	898	3.1	7.6
10. Tertiary Urban	100	0.3	0.2	653	2.3	2.7	753	2.6	2.9
Total Arterial Classes	6,124	21.1	27.4	4,130	14.4	57.8	10,254	35.5	85.2
11. Total Roads and Streets	9,504	33.0	4.8	9,084	31.5	10.0	18,588	64.5	14.8
Total	15,628	54.1	32.2	13,214	45.9	67.8	28,842	100.0	100.0

Miles by Functional Class and Existing Administrative Responsibility

Class	State Highways	City Streets	Town Roads	MDC	Toll Facilities	Other	Total
1. Interstate	318	—	—	—	135	—	453
2. Principal	666	119	68	38	6	1	898
3. Major	448	180	284	2	—	1	915
4. Collector	494	40	385	—	—	—	919
5. Community Service	358	47	814	2	—	2	1,223
6. Regional Arterial	180	107	1,550	—	—	12	1,849
7. Town Arterial	50	145	1,763	7	—	2	1,967
8. Primary Urban	18	250	77	34	—	—	379
9. Secondary Urban	49	454	365	30	—	—	898
10. Tertiary Urban	8	311	426	8	—	—	753
Total Arterial Classes	2,589	1,653	5,732	121	141	18	10,254
11. Local Roads and Streets	99	4,790	13,510	28	—	161	18,588
Total	2,688	6,443	19,242	149	141	179	28,842

Mileage of Recommended Systems by City and Town

City or Town*	State-owned Systems		Municipally-owned Systems		
	Primary (miles)	Secondary (miles)	Major (miles)	Minor (miles)	Access (miles)
Abington	7.4	1.7	4.9	9.2	31.4
Acton	4.4	11.2	7.9	8.6	56.7
Acushnet	—	9.2	6.9	2.1	32.8
Adams	4.6	2.0	.4	16.7	40.0
Agawam	1.4	15.4	12.1	19.6	62.0
Alford	—	—	1.4	4.1	11.9
Amesbury	5.2	7.2	3.1	8.2	44.8
Amherst	11.9	5.8	21.2	6.6	36.8
Andover	11.4	12.3	17.6	3.8	112.8
Arlington	5.6	—	7.5	5.6	85.9
Ashburnham	6.1	3.3	8.1	11.4	53.2
Ashby	—	8.5	3.5	8.4	43.4
Ashfield	—	14.3	3.6	11.9	51.9
Ashland	1.7	3.0	6.4	5.3	35.4
Athol	5.1	11.5	5.6	15.7	67.7
ATTLEBORO	19.8	6.9	17.2	21.1	102.1
Auburn	8.0	—	12.6	9.0	61.9
Avon	4.0	—	3.8	3.6	19.2
Ayer	—	7.0	4.0	1.8	19.7
Barnstable	22.4	27.5	28.5	25.3	182.3
Barre	—	24.2	—	14.0	65.4
Becket	—	18.0	1.8	12.6	39.7
Bedford	2.5	10.2	5.0	10.0	37.2
Belchertown	17.5	8.9	9.2	12.9	69.1
Bellingham	12.2	4.7	2.5	1.6	58.3
Belmont	8.7	—	6.0	6.3	64.4
Berkley	3.2	8.5	2.3	2.3	31.5
Berlin	1.8	7.0	1.0	6.1	25.3
Bernardston	8.4	—	1.7	8.5	31.6
BEVERLY	9.3	8.4	8.0	7.3	87.1
Billerica	5.1	13.9	10.3	17.6	109.6
Blackstone	0.1	2.1	11.6	—	26.1
Blandford	—	8.0	11.6	13.8	40.5
Bolton	8.4	6.7	3.8	11.3	27.0
BOSTON	54.9	—	160.1	41.1	586.1
Bourne	19.8	1.6	17.1	11.1	64.0
Boxborough	3.3	—	3.7	3.7	18.1
Boxford	5.1	5.3	15.5	4.1	40.8
Boylston	0.7	10.0	3.1	1.1	28.6
Braintree	17.3	—	15.5	10.8	87.2
Brewster	2.9	7.9	10.3	2.5	30.2
Bridgewater	3.1	14.2	12.6	6.8	44.5
Brimfield	8.8	6.6	9.1	4.6	47.1
BROCKTON	15.6	6.4	27.2	20.3	140.2
Brookfield	2.4	5.3	2.6	8.0	21.0
Brookline	6.2	—	13.4	6.3	71.1
Buckland	.6	5.2	7.0	3.0	30.1
Burlington	5.7	9.8	7.8	3.8	70.2
CAMBRIDGE	9.3	—	23.2	4.3	90.4
Canton	10.6	7.8	6.8	6.5	43.0
Carlisle	—	5.2	4.7	3.8	31.4
Carver	4.4	13.6	1.5	4.3	41.1
Charlemont	12.0	—	14.3	.6	23.2
Charlton	10.9	3.3	20.4	6.0	80.5
Chatham	—	7.3	4.1	6.5	36.8
Chelmsford	16.7	12.0	15.8	5.7	108.1
CHELSEA	2.1	—	8.6	0.6	34.2
Cheshire	6.8	2.6	6.0	6.4	32.8
Chester	—	6.4	4.6	13.6	34.3
Chesterfield	—	—	15.9	6.8	30.3
CHICOPEE	18.3	—	28.4	11.0	140.4
Chilmark	—	7.7	—	9.6	4.7
Clarksburg	—	2.8	—	6.0	7.9
Clinton	—	8.1	3.5	4.2	28.6
Cohasset	—	3.9	6.0	1.6	35.2
Colrain	—	—	17.4	8.9	53.2
Concord	5.2	11.1	8.6	9.9	60.1
Conway	—	6.5	12.9	7.7	35.9
Cummington	9.3	—	7.2	7.3	32.7
Dalton	4.1	2.5	7.2	4.9	23.1
Danvers	11.4	6.2	11.1	10.1	62.1
Dartmouth	9.1	9.1	20.3	34.3	88.1
Dedham	12.4	1.7	12.0	5.6	51.3
Deerfield	7.1	11.5	3.2	25.4	45.6
Dennis	5.3	11.7	7.1	15.8	77.6
Dighton	1.6	5.8	7.2	12.8	29.3
Douglas	8.6	4.4	11.4	4.4	42.3
Dover	0.7	3.6	4.9	6.8	30.9
Dracut	3.3	6.5	11.2	5.7	85.2
Dudley	6.1	—	18.0	5.2	46.0
Dunstable	—	—	5.8	5.3	22.9
Duxbury	6.3	5.4	14.6	11.0	57.4
E. Bridgewater	—	12.2	11.4	4.4	30.4
E. Brookfield	2.9	0.8	7.1	1.3	10.0
E. Longmeadow	—	10.2	11.8	8.8	33.9
Eastham	6.2	0.1	1.1	7.6	25.1
Easthampton	3.9	6.3	11.9	6.6	40.8
Easton	11.3	6.7	7.7	12.1	42.1
Edgartown	—	10.1	—	8.5	30.5
Egremont	—	4.0	7.7	8.7	19.1
Erving	8.9	5.3	—	2.1	11.4
Essex	4.7	—	4.9	—	16.6
EVERETT	6.7	—	3.9	1.8	47.4
Fairhaven	6.0	0.6	8.9	2.6	68.7
FALL RIVER	15.8	4.2	27.2	21.3	178.1
Falmouth	18.8	10.1	16.4	36.5	108.2
FITCHBURG	14.6	5.2	21.4	18.7	119.4
Florida	6.9	—	10.0	6.0	22.0
Foxborough	7.4	12.0	6.1	5.5	48.2
Framingham	13.9	8.1	13.2	16.1	151.2
Franklin	4.9	14.1	9.8	5.8	63.6
Freetown	7.6	3.4	16.9	11.6	39.6
GARDNER	14.0	2.7	9.3	5.9	62.9

City or Town*	State-owned Systems		Municipally-owned Systems		
	Primary (miles)	Secondary (miles)	Major (miles)	Minor (miles)	Access (miles)
Gay Head	—	3.4	—	1.7	6.6
Georgetown	6.9	2.3	6.2	—	26.9
Gill	3.9	.2	6.5	5.0	21.6
GLOUCESTER	10.9	10.9	8.0	4.7	84.2
Goshen	5.4	1.9	1.8	4.8	18.5
Gosnold	—	—	—	—	2.0
Grafton	—	16.9	8.8	5.0	51.2
Granby	7.6	8.5	1.5	15.6	29.4
Granville	—	—	17.6	14.0	31.3
Gt. Barrington	7.9	14.2	2.2	20.7	48.3
Greenfield	15.2	7.2	6.1	22.4	65.5
Groton	—	16.8	.8	9.3	53.8
Groveland	2.6	1.8	6.3	—	28.0
Hadley	5.0	14.8	8.5	6.4	32.6
Halifax	—	7.6	—	2.1	4.0
Hamilton	—	3.9	3.6	5.7	32.2
Hampden	—	—	13.4	2.4	29.2
Hancock	3.2	7.9	1.8	—	14.4
Hanover	1.3	3.0	15.1	11.2	32.5
Hanson	—	6.5	10.2	7.1	22.4
Hardwick	—	14.2	3.9	14.2	50.3
Harvard	6.8	6.9	2.4	9.3	43.4
Harwich	10.0	4.8	14.4	16.1	54.2
Hatfield	3.7	6.5	6.2	6.3	32.9
HAVERHILL	23.3	5.8	22.4	7.4	144.4
Hawley	—	—	6.9	8.8	32.6
Heath	—	—	13.3	8.0	29.9
Hingham	11.0	5.0	10.8	9.2	65.3
Hinsdale	—	5.2	4.7	4.7	27.3
Holbrook	6.8	—	5.4	1.8	31.5
Holden	6.8	11.2	4.6	18.9	58.3
Holland	0.9	—	8.2	4.2	21.0
Holliston	5.6	9.2	.9	3.8	50.0
HOLYOKE	20.6	1.8	20.9	10.0	92.1
Hopedale	—	2.7	0.7	2.8	13.0
Hopkinton	5.5	18.4	1.6	.3	51.3
Hubbardston	8.2	5.7	10.5	4.2	43.2
Hudson	.5	7.0	3.9	12.9	50.5
Hull	5.7	1.2	1.2	—	44.2
Huntington	—	10.1	5.7	2.9	31.5
Ipswich	6.1	7.8	8.9	4.9	53.3
Kingston	3.1	11.4	3.4	6.3	30.8
Lakeville	4.7	12.0	10.5	9.2	30.5
Lancaster	9.0	4.0	8.0	5.2	32.8
Lanesborough	9.1	—	5.9	2.5	41.2
LAWRENCE	13.3	1.2	10.8	2.0	108.0
Lee	6.9	4.4	8.1	6.7	34.2
Leicester	12.1	3.0	3.3	6.6	54.2
Lenox	7.8	5.0	5.6	8.6	28.7
LEOMINSTER	13.7	1.6	15.8	18.4	92.8
Leverett	—	5.5	15.6	5.0	12.9
Lexington	14.1	3.0	19.5	11.8	79.6
Leyden	—	—	—	10.2	23.4
Lincoln	3.1	8.9	3.1	4.7	35.0
Littleton	7.5	10.0	4.9	4.1	42.6
Longmeadow	3.4	7.8	9.3	.7	61.9
LOWELL	17.4	2.6	25.1	8.4	174.1
Ludlow	1.1	15.2	8.2	10.7	62.5
Lunenburg	5.5	6.9	12.6	5.9	44.9
LYNN	14.1	—	14.1	2.4	117.8
Lynnfield	4.6	3.7	7.3	2.3	42.3
Malden	8.1	—	11.0	3.2	75.6
Manchester	3.7	6.3	1.8	—	15.2
Mansfield	9.4	0.9	14.9	5.2	42.0
Marblehead	—	2.9	4.8	6.1	48.8
Marion	4.8	—	1.8	4.0	20.7
MARLBOROUGH	12.8	3.4	—	13.9	96.3
Marshfield	1.0	10.0	14.4	15.0	89.1
Mashpee	3.5	7.0	3.2	6.3	21.4
Mattapoisett	4.6	—	—	6.6	26.5
Maynard	—	7.8	—	—	25.2
Medfield	8.8	1.4	1.6	3.1	44.5
MEDFORD	12.4	—	8.9	4.7	71.8
Medway	7.8	9.8	0.4	—	35.2
MELROSE	2.7	—	5.5	2.3	65.3
Mendon	—	7.8	11.2	2.5	18.0
Merrimac	2.6	—	3.3	7.1	20.6
Methuen	16.5	3.3	19.0	5.7	113.5
Middleborough	21.3	8.5	22.2	29.0	97.0
Middlefield	—	—	5.7	12.4	19.0
Middleton	5.2	5.0	2.1	2.0	22.7
Milford	4.5	11.6	8.1	3.8	48.9
Millbury	5.2	6.2	11.0	1.9	38.9
Millis	4.0	7.6	1.1	2.7	29.6
Millville	0.3	5.1	2.4	0.5	9.8
Milton	10.0	—	13.3	7.2	64.5
Monroe	—	—	3.5	6.0	7.2
Monson	0.4	15.1	14.4	3.6	80.3
Montague	—	21.1	10.2	5.5	68.5
Monterey	—	7.1	1.7	5.9	34.7
Montgomery	—	—	5.3	3.0	19.4
Mt. Washington	—	—	—	7.9	10.2
Nahant	—	3.6	1.8	—	11.2
Nantucket	—	8.4	7.5	30.9	97.2
Natick	11.1	2.0	10.3	4.1	97.2
Needham	10.9	2.2	6.8	3.6	85.2
New Ashford	3.5	—	—	—	13.7
NEW BEDFORD	18.9	1.9	41.5	10.4	191.0
New Braintree	—	9.6	7.5	5.6	25.8
New Marlborough	—	—	16.4	13.9	56.8
New Salem	8.2	3.6	—	6.1	30.7
Newbury	2.6	4.0	11.8	3.8	30.7
NEWBURYPORT	3.3	6.4	7.3	.8	45.9
NEWTON	18.2	—	21.8	17.3	211.7
Norfolk	—	6.7	9.7	0.3	30.6

City or Town*	State-owned Systems		Municipally-owned Systems		
	Primary (miles)	Secondary (miles)	Major (miles)	Minor (miles)	Access (miles)
NO ADAMS	11.9	4.0	5.7	16.2	40.7
No. Andover	13.1	2.3	8.9	4.8	71.3
No. Attleborough	6.1	9.0	7.2	23.0	53.2
No. Brookfield	—	18.8	—	—	52.0
No. Reading	—	9.0	1.3	2.9	38.9
NORTHAMPTON	16.7	10.8	23.9	17.1	69.8
Northborough	4.4	12.8	2.5	6.7	43.1
Northbridge	0.2	15.4	11.4	2.8	29.4
Northfield	4.7	13.0	3.4	3.7	45.8
Norton	11.7	—	11.8	8.6	45.8
Norwell	6.0	5.1	7.0	10.7	37.3
Norwood	5.0	7.9	4.1	3.4	75.4
Oak Bluffs	—	7.0	3.3	4.3	22.3
Oakham	—	6.8	—	9.5	33.1
Orange	7.1	10.6	3.7	15.2	59.1
Orleans	3.4	6.5	5.0	6.3	31.2
Otis	—	16.5	1.2	10.2	29.8
Oxford	11.8	3.1	9.0	0.7	59.1
Palmer	6.7	24.5	8.2	4.9	52.4
Paxton	6.7	6.5	—	3.2	21.4
PEABODY	10.8	2.2	14.0	9.2	111.6
Pelham	10.0	—	1.8	5.8	9.9
Pembroke	1.3	3.8	15.0	14.4	47.9
Pepperell	—	13.3	3.2	5.6	44.7
Peru	—	—	8.2	0.5	26.3
Petersham	—	17.9	2.3	7.8	49.5
Phillipston	3.0	—	4.5	10.0	30.8
PITTSFIELD	19.3	1.0	19.2	34.0	132.4
Plainfield	—	7.0	5.0	5.7	29.9
Plainville	1.0	7.3	3.7	4.8	28.6
Plymouth	18.4	23.2	5.6	37.9	116.5
Plympton	—	5.3	4.8	3.9	17.5
Princeton	—	20.0	3.5	8.7	42.9
Provincetown	4.9	6.8	1.1	0.8	8.9
QUINCY	15.9	—	23.7	10.6	138.1
Randolph	13.0	—	7.1	4.7	59.5
Raynham	9.3	4.3	10.0	5.7	37.0
Reading	2.1	7.0	6.0	5.2	57.7
Rehoboth	7.0	12.3	13.4	13.6	74.5
REVERE	16.1	—	6.9	6.1	69.2
Richmond	—	7.8	5.3	5.4	23.1
Rochester	—	8.6	6.0	7.1	35.4
Rockland	5.5	2.3	7.2	3.0	33.1
Rockport	—	4.5	4.3	—	25.6
Rowe	—	—	7.6	5.2	22.5
Rowley	5.2	3.6	3.6	3.0	24.4
Royalston	—	6.4	15.4	7.6	37.4
Russell	—	9.6	5.0	1.3	10.3
Rutland	12.5	9.3	2.8	0.5	57.4
SALEM	8.6	0.7	3.8	2.1	58.2
Salisbury	3.2	15.9	—	—	27.7
Sandisfield	—	7.9	10.9	7.9	53.2
Sandwich	7.0	13.8	7.0	11.2	47.0
Saugus	12.1	—	10.6	2.7	67.1
Savory	1.7	7.6	—	17.0	28.3
Scituate	—	5.7	15.1	10.5	75.0
Seekonk	12.3	5.3	3.9	18.0	45.9
Sharon	9.9	5.5	4.7	7.8	64.7
Sheffield	8.4	—	13.0	13.8	60.3
Shelburne	7.8	—	5.3	4.6	42.0
Sherborn	9.0	1.0	1.1	4.5	32.1
Shirley	—	16.4	—	1.9	29.2
Shrewsbury	14.0	9.8	9.3	9.7	55.7
Shutesbury	3.1	—	8.4	2.7	24.1
Somerset	2.4	9.8	8.3	4.8	57.0
SOMERVILLE	6.2	—	14.4	2.4	73.6
S. Hadley	10.3	3.6	5.4	11.5	46.3
Southhampton	5.5	—	6.5	7.5	43.5
Southborough	9.6	4.0	8.0	6.5	35.9
Southbridge	6.5	7.2	5.4	7.4	52.1
Southwick	7.0	3.2	11.4	13.1	35.9
Spencer	4.4	13.1	—	16.9	61.7
SPRINGFIELD	32.2	10.3	55.1	21.3	329.5
Sterling	6.0	14.2	—	18.4	46.6
Stockbridge	5.5	11.5	1.8	—	29.5
Stoneham	2.4	—	8.6	3.2	40.2
Stoughton	6.8	6.8	8.8	6.6	71.3
Stow	—	7.2	2.8	7.4	28.1
Sturbridge	15.9	3.4	8.5	11.7	59.2
Sudbury	5.1	10.2	4.3	7.7	70.3
Sunderland	—	11.4	1.0	3.5	17.6
Sutton	6.8	7.8	18.7	2.5	56.4
Swampscott	1.7	2.7	—	2.2	39.5
Swansea	6.8	9.3	6.3	8.0	63.1
TAUNTON	20.6	15.2	16.7	23.7	116.6
Templeton	6.1	15.1	17.0	—	50.1
Tewksbury	3.6	6.0	12.2	9.4	72.9
Tisbury	—	4.4	—	6.3	16.4
Tolland	—	—	5.4	5.3	26.6
Topsfield	1.6	11.9	2.9	1.5	35.8
Townsend	6.4	8.8	7.4	—	47.3
Truro	10.0	—	4.6	5.3	28.8
Tyngsborough	3.4	4.0	11.8	1.9	33.5
Tyringham	—	—	6.3	1.2	15.5
Upton	—	13.8	5.0	2.5	36.5
Uxbridge	8.9	13.2	5.9	13.1	52.8
Wakefield	7.6	2.3	9.7	3.2	52.2
Wales	—	5.1	3.7	5.2	13.5
Walpole	4.8	7.5	10.5	7.0	62.5
WALTHAM	9.8	1.7	18.1	10.4	75.4
Ware	9.4	7.7	0.8	19.7	48.2
Wareham	8.7	10.4	3.5	14.6	82.7
Warren	—	10.2	8.5	5.9	42.7
Warwick	—	8.2	4.3	11.6	36.2
Washington	—	4.5	6.8	1.3	35.8

City or Town*	State-owned Systems		Municipally-owned Systems		
	Primary (miles)	Secondary (miles)	Major (miles)	Minor (miles)	Access (miles)
Watertown	4.3	—	5.8	4.0	61.3
Wayland	3.2	12.6	2.1	4.0	49.2
Webster	4.4	—	9.2	6.7	38.5
Wellesley	12.6	—	10.1	2.4	105.8
Wellfleet	7.2	—	6.6	6.2	25.3
Wendell	—	—	8.1	6.3	34.5
Wenham	0.9	9.6	1.1	3.6	11.7
W. Boylston	4.5	6.0	2.5	7.7	31.2
W. Bridgewater	5.6	6.4	10.3	0.9	27.2
W. Brookfield	7.0	2.2	3.2	4.3	39.3
W. Newbury	0.8	5.4	9.0	0.6	31.7
W. Springfield	13.5	3.5	17.6	9.0	76.3
W. Stockbridge	—	10.6	1.2	7.0	19.4
W. Tisbury	—	8.7	—	9.0	5.6
Westborough	7.1	12.0	8.2	—	46.6
WESTFIELD	13.7	7.0	29.6	19.9	94.1
Westford	5.3	17.1	15.4	5.2	54.9
Westhampton	—	4.5	14.5	4.0	18.0
Westminister	7.0	4.1	13.6	7.5	64.3
Weston	5.4	6.3	3.7	13.8	47.9
Westport	13.4	15.4	16.7	10.8	64.1
Westwood	5.2	2.1	1.8	14.3	45.6
Weymouth	10.2	—	23.3	8.7	115.9
Whately	3.9	3.2	9.3	10.3	16.1
Whitman	—	6.4	7.6	2.2	30.3
Wilbraham	6.3	13.0	3.0	13.4	47.6
Williamsburg	5.7	—	14.1	1.3	24.3
Williamstown	15.1	3.1	8.4	7.6	40.0
Wilmington	5.2	16.8	1.7	10.3	47.9
Winchendon	10.6	8.6	8.5	5.0	73.1
Winchester	4.3	—	3.7	9.5	50.9
Windsor	8.2	3.2	—	6.0	54.7
Winthrop	1.7	—	2.8	3.3	30.7
WOBURN	8.5	2.6	13.9	10.8	94.3
WORCESTER	53.2	2.0	48.3	19.9	252.2
Worthington	—	—	15.9	8.9	38.3
Wrentham	3.5	12.5	8.5	2.9	45.4
Yarmouth	10.2	12.2	8.0	12.4	108.9
TOTALS	2,124.5	2,141.8	3,049.5	2,702.5	18,399.4

* City names in capitals